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PROPOSED LANDFILL GAS MONITORING NETWORK REPORT

NORTH WAKE COUNTY LANDFILL
RALEIGH, NORTH CAROLINA

SOLID WASTE PERMIT NO. 92-09

Prepared for:

NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
Division of Waste Management
Solid Waste Section
401 Oberlin Road, Suite 150
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Submitted by:

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Received JUL 2005 Solid Waste Section

On Behalf of:

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May 11, 2005
File No. 02199312.01

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May 11, 2005
File No. 02199312.01

Mr. James Coffey
NCDENR
Division of Waste Management, Solid Waste Section
401 Oberlin Road, Suite 150
Raleigh, North Carolina 27605

Received
JUL 2005
Solid Waste Section

Subject: Landfill Gas Monitoring Network Reconfiguration and Probe Decommissioning Protocol, Closed Cell
North Wake County Landfill – Raleigh, North Carolina
Solid Waste Permit No. 92-09

Dear Mr. Coffey:

On behalf of Wake County (County) and the North Wake County Landfill (Landfill), SCS Engineers, PC (SCS) hereby submits this protocol to the North Carolina Department of Environment and Natural Resources (NCDENR) for reconfiguring the landfill gas (LFG) monitoring network and implementing a routine LFG monitoring program at the Landfill's closed cell.

This proposed reconfiguration consists primarily of the decommissioning of select temporary probes that were installed and monitored to establish the extent of landfill gas (LFG) migration and were used to provide a basis of design for an active LFG remediation system around the perimeter of the waste footprint of the closed cell. Once the LFG remediation system was installed, the temporary probes were then used to verify the effectiveness of the LFG remediation system.

This protocol includes:

- An overview of the Landfill, Landfill Gas Collection and Control System (GCCS), permanent LFG monitoring probes, perimeter methane migration remediation system, and temporary LFG monitoring probes;
- A summary and analysis of the LFG migration data; and,
- A presentation of the proposed LFG monitoring network, including locations for new permanent LFG monitoring probes.

The Landfill is requesting NCDENR's approval to commence probe installation and abandonment as outlined herein. The routine LFG monitoring events will incorporate the reconfigured probe network upon completion of the new permanent LFG monitoring probes.

If you have questions, please feel free to contact Erin Conklin at (704) 504-3107 or Bob Dick at the letterhead address.

Sincerely,

Erin C. Conklin / [illegible]

Erin C. Conklin
Staff Engineer

Robert E. Dick

Robert E. Dick, PE
Project Director
SCS ENGINEERS, PC

Attach.

cc: Dan LaMontagne, Wake County
Johnny Beal, Wake County

3229 Anderson Highway
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SCS ENGINEERS *letter of transmittal*

TO: **MATT GAMBLE**
NCDENR
RALEIGH REGIONAL OFFICE
1617 MAIL SERVICE CENTER
RALEIGH, NC 27699-1646

CC: **ERIN CONKLIN** (1 copy)

DATE: 6/11/05

JOB NO: 02199312.01

RE: NORTH WAKE COUNTY LANDFILL
RALEIGH, NORTH CAROLINA

Received
JUL 2005
Solid Waste Section

WE ARE SENDING YOU:

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  - ☐ Plans
  - ☐ Specifications
- ☐ Under Separate Cover Via _____
  - ☐ Prints
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COPIES	DATE	DESCRIPTION
1	5/11/05	PROPOSED LANDFILL GAS MONITORING NETWORK REPORT

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REMARKS:

Two copies of the report were distributed to Mr. James Coffey with the NCDENR on 5/11/05. An additional copy is attached per your request.

SIGNED: : Robert E. Dick / cdb

ROBERT E. DICK, PE

If enclosures are not as noted, kindly notify us at once.

CASE SERVICES

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1.0 INTRODUCTION

This report has been prepared to present a new landfill gas (LFG) monitoring probe network and to provide the rationale to decommission most of the existing temporary LFG monitoring probes and replace other temporary probes with permanent LFG monitoring probes at the North Wake County Landfill (Landfill) located in Raleigh, North Carolina.

This report has been prepared by SCS Engineers, PC for the Landfill. This report is being submitted to the North Carolina Department of Environment and Natural Resources (NCDENR) for review and approval.

This report consists of the following sections:

- An overview of the Landfill, Landfill Gas Collection and Control System (GCCS), permanent LFG monitoring probes, perimeter methane migration remediation system, and temporary LFG monitoring probes;
- A summary and analysis of the LFG migration data; and,
- A presentation of the proposed LFG monitoring network, including locations for new permanent LFG monitoring probes.

2.0 SITE CONDITIONS

This section provides an overview of the Landfill, GCCS, permanent LFG monitoring probes, perimeter methane migration remediation system, and temporary LFG monitoring probes.

2.1 Landfill

The Landfill is owned by Wake County, North Carolina (County). A private company, Santek Environmental, Inc. (Santek), manages landfill operations under a contract agreement with Wake County. The Landfill currently accepts municipal solid waste (MSW) from the Raleigh-Wake County Metropolitan area. No hazardous, liquid, or infectious waste is accepted. Waste placement and compaction is completed in accordance with the filling plan submitted under the Landfill permit and standard Santek operating procedures. The site is located on Deponie Drive near Raleigh, North Carolina.

The Landfill is comprised of a Closed (unlined) Landfill and an Active (Lined) Landfill. The Active Landfill is divided into 11 cells covering approximately 69 acres in area. The Closed Landfill is located in the northeast portion of the Landfill property. It is approximately 36 acres in area and has approximately 1.4 million Mg of refuse in-place. The Closed Landfill opened in 1986 and closed in 1997, at which time a final cover system was installed. This report addresses the LFG controls associated with the Closed Landfill.

2.2 LFG Collection and Control System

The GCCS was initially installed in the Closed Landfill in 1997 and expanded in 1998 to include the Active Landfill. Additional expansions of the GCCS were made in 2000 to the Closed Landfill and in 2001 to the Active Landfill. The Closed Landfill GCCS consists of 37 vertical gas extraction wells that average approximately 50 feet in depth. The Active GCCS consists of 16 vertical gas extraction wells and 8 horizontal collectors. The GCCS in both the closed and active Landfills is operated by Wake Gas Producers (WPG), under Air Permit No. 08890T00 held by Wake County.

Existing wellfield piping was designed and installed to promote gravity flow of LFG condensate to condensate knock-outs (KO). On the Closed Landfill, collected LFG condensate is pumped from the KO's to the leachate holding pond. Condensate collected from the Active Landfill LFG system is drained back into the leachate collection system. The combined condensate/leachate is then pumped to an onsite leachate holding facility, where it is temporarily held before being pumped to the local municipal wastewater treatment facility for ultimate disposal.

The GCCS at the Landfill supplies LFG as fuel via a pipeline for a 34 MMBtu per hour steam boiler at Mallinckrodt Chemical, an offsite facility located east of the Landfill. The boiler is operated by Raleigh Steam Producers under Air Permit No. 8361R02 with the NCDENR Division of Air Quality. Vacuum is provided to the LFG collection system through the use of an 8-stage centrifugal blower manufactured by Hoffman. The blower has a maximum flow rating of 1,250 scfm. The blower can direct the collected LFG to the transmission pipeline and/or a 1,250 scfm LFG Specialties utility flare located onsite to combust excess LFG.

Drawing No. 1 provided in Appendix A illustrates the GCCS in the Closed Landfill. The vertical gas extraction wells are designated as EW-01 through EW-37.

2.3 Permanent LFG Monitoring Probes

Nine permanent LFG monitoring probes are located around the perimeter of the Closed Landfill as shown on Drawing No. 1 in Appendix A. The nine probes, designated M-1 through M-9, are routinely monitored to determine the presence of LFG (specifically methane gas) in accordance with 15A NCAC 13B Section .1626(4)(b).

2.4 Perimeter Methane Migration Remediation System

In response to elevated methane readings in permanent LFG monitoring probe M-6 on the eastern side of the Closed Landfill, Wake County submitted an initial Gas Migration Remediation Plan on March 3, 1999 to NCDENR. The Gas Migration Remediation Plan consisted of the installation of an active 200-foot long horizontal collector in the waste mass parallel to the toe of slope opposite M-6. The intent of the horizontal collector was to intercept the lateral movement of LFG inside the waste mass, thereby preventing migration from the cell.

After discovery of distressed vegetation on the western side of the cell in October 2000, the County initiated a comprehensive migration investigation, developed a remediation program, and installed a perimeter methane migration remediation system including, but not limited to, the following:

- Installation of 78 perimeter methane migration remediation extraction wells, designated as EXW-1 through EXW-78, outside the waste mass and along the western and northern boundaries of the cell, and

- Installation of a 1,000-foot long and 30-foot deep LFG cutoff trench outside the waste mass and along the eastern boundary of the cell.

The installed perimeter methane migration remediation system was made active by connecting it to the existing GCCS. Drawing No. 1 in Appendix A illustrates the perimeter methane migration remediation system constructed at the Closed Landfill.

Currently WGP, which has operated the GCCS in both the Closed and Active Landfills since they were installed in 1997, is responsible for operating the perimeter methane migration remediation system. WGP follows a standard operating procedure (SOP) that was created specifically for operating and maintaining this system with the objective of migration mitigation and regulatory compliance.

2.5 Temporary LFG Monitoring Probes

In concert with the LFG migration remedial measures discussed above in Section 2.4, the County installed 111 temporary LFG monitoring probes using direct-push technology around the perimeter of the Closed Landfill. For purposes of this report, these probes are referred to as the

"temporary LFG monitoring probes". These probes, designated G-1 through G-107, were installed between 2000 and 2001, and their locations are shown on Drawing No. 1 in Appendix A.

During the past several years, these probes have been monitored and evaluated to supplement the permanent LFG monitoring probes in detecting LFG migration during the installation of the perimeter methane migration remediation system. More recently, these probes have been routinely monitored using an appropriate field instrument to measure gas quality and subsurface pressures to assess the effectiveness of the perimeter methane migration remediation system installed around the Closed Landfill.

3.0 LFG MIGRATION DATA AND ANALYSIS

This section provides an analysis of the LFG monitoring data from the 111 temporary LFG monitoring probes. Monitoring data from the temporary LFG monitoring probes collected from October 26, 2000 to October 8, 2004 was used in this analysis. The monitoring data was provided by the County, Camp Dresser & McKee Inc. (CDM), and SCS Engineers, PC.

3.1 LFG Migration Data

A review of the monitoring results of the 111 temporary LFG monitoring probes indicates that forty-two (42) probes have never detected methane gas concentrations above the regulatory limit of 5 percent. These 42 probes are identified in Table 1 below and shown on Figure 1.

TABLE 1
TEMPORARY LFG MONITORING PROBES NEVER INDICATING METHANE ABOVE THE REGULATORY LIMIT

West Side			North Side	East Side	South Side
G-4	G-20	G-86	G-66	G-33	G-65
G-6	G-22	G-87	G-67	G-34	-----
G-8	G-23	G-100	G-94	G-35	-----
G-10	G-24A	G-101	G-98	G-36	-----
G-13	G-24B	G-102	-----	G-40	-----
G-14	G-25	G-103	-----	G-55	-----
G-15	G-27	G-104	-----	G-56	-----
G-16	G-28	G-105	-----	G-57	-----
G-18A	G-79	-----	-----	G-58	-----
G-18B	G-82	-----	-----	-----	-----

In addition, a graphical presentation of the monitoring data from each of these 42 temporary LFG monitoring probes is provided in Appendix B.

Of the remaining sixty-nine (69) temporary LFG monitoring probes, all of them have indicated methane gas concentrations above the regulatory limit on at least one occasion. However, of these 69 probes, the methane gas concentrations in forty-seven (47) have decreased over time to below the regulatory threshold. These 47 probes are listed below in Table 2 and shown on Figure 2 at the end of this subsection.

TABLE 2
TEMPORARY LFG MONITORING PROBES
DEMONSTRATING DECREASING METHANE TREND

West Side		North Side	East Side		South Side
G-1	G-26	G-68	G-29	G-54	G-60
G-2	G-80	G-69	G-30	G-75	-----
G-3	G-81	G-70	G-32	G-76	-----
G-5	G-83	G-71	G-37	G-78	-----
G-7	G-84	G-93	G-39	-----	-----
G-9	G-85	G-95	G-43	-----	-----
G-11	G-88	G-96	G-44	-----	-----
G-12	G-89	G-97	G-45	-----	-----
G-17A	G-90	G-99	G-47	-----	-----
G-17B	G-91	-----	G-49	-----	-----
G-19	G-92	-----	G-50	-----	-----

In addition, a graphical representation of the monitoring data from each of these 47 probes is provided in Appendix C.

Of the remaining twenty-two (22) temporary LFG monitoring probes that have not demonstrated a decreasing trend in methane gas concentration, twelve (12) of the probes are located to the east of the cell, three to the north, five to the south, and two to the west. These remaining probes are listed below in Table 3.

TABLE 3
TEMPORARY LFG MONITORING PROBES
NOT DEMONSTRATING DECREASING METHANE TREND

West Side	North Side	East Side		South Side
G-21A	G-72/G-72R	G-31	G-51	G-59
G-21B	G-106	G-38	G-52	G-61
-----	G-107	G-41	G-53	G-62
-----	-----	G-42	G-73	G-63
-----	-----	G-46	G-74	G-64
-----	-----	G-48	G-77	-----

For further information, a graphical presentation of the monitoring data for each probe from Table 3 is shown in Appendix D.

3.2 Analysis of LFG Migration Data

Based on the LFG migration data for the temporary LFG monitoring probes evaluated in the previous subsection, the following analysis of the LFG migration data is provided:

- Methane gas concentrations above 5 percent have never been detected in 42 of the 111 temporary LFG monitoring probes (Table 1). At least nine of these probes have

never indicated methane levels above detectable limits. In addition to never indicating the presence of methane gas concentrations above 5 percent, these 42 probes currently have active perimeter extraction wells located between them and the waste mass. Furthermore, many of these temporary probes are positioned in close proximity to an existing or proposed permanent monitoring probe. **Based on this analysis, it is SCS' opinion that the use of these probes is no longer warranted, and it is recommended to decommission these 42 probes.**

- Methane gas concentrations have decreased to levels below the regulatory threshold in an additional 47 probes (Table 2). This decreasing trend is evidence that the perimeter methane migration remediation system is successfully working to control LFG migration in these areas. Many of these temporary probes are positioned in close proximity to an existing or proposed permanent monitoring probe. **Based on this analysis, it is SCS' opinion that the use of these probes is no longer warranted, and it is recommended to decommission these 47 probes.**

The use of the term "decommission" in regards to the temporary LFG monitoring probes is defined as the abandonment of the probes according to the requirements of 15A NCAC 2C .0113(b)(G). Also, as required by 15A NCAC .0114(b), a record of abandonment for the temporary probes will be submitted to NCDENR within 30 days of completion of the abandonment.

- Methane gas concentrations in the remaining 22 temporary LFG monitoring probes are above detectable limits on a somewhat consistent basis and have not demonstrated a decreasing trend at this time. **In order to determine the success of the perimeter methane migration remediation system, SCS proposes that these remaining 22 probes remain in place and continue to be monitored on a monthly basis.** After 6 months of additional monitoring, SCS will evaluate the additional data and re-assess the necessity of these probes.

4.0 PROPOSED LFG MONITORING NETWORK

A network of permanent LFG monitoring probes around the Closed Landfill is required by 15 NCAC 13B .1626(4)(b) to monitor LFG migration. The number and location of these probes is dependent on several factors including local geology, depth of waste, and the size of the landfill. For a site that has experienced LFG migration, additional probes are needed to comprehensively monitor potential LFG migration.

This section presents the LFG monitoring probe network and frequency for routine monitoring events for the Closed Landfill.

4.1 LFG Monitoring Probe Network

Following the decommissioning of 89 temporary LFG monitoring probes (Tables 1 and 2), a network of 22 temporary LFG monitoring probes and nine permanent LFG monitoring probes will remain. Based on a review of this remaining network of probes, SCS is recommending the Landfill install seven additional permanent LFG monitoring probes to increase the coverage of the permanent probe network. Five of the new probes (designated M-19 through M-23) will be located on the southwest and west sides of the Closed Landfill and two (designated M-24 and M-25) on the southeast side of the Closed Landfill. The locations of the seven proposed new permanent LFG monitoring probes are based on an evaluation of the existing LFG monitoring probe network, the subsurface hydrogeological conditions, and the proximity to offsite structures. These seven new permanent LFG monitoring probes will be incorporated into the permanent network for monitoring LFG migration and will be monitored during the routine monitoring performed at the site.

The proposed new network of LFG monitoring probes will consist of the following:

- 22 temporary LFG monitoring probes;
- 9 existing permanent LFG monitoring probes; and,
- 7 proposed permanent LFG monitoring probes.

The location of these monitoring probes is shown on Figure 3.

It is SCS' professional opinion that this network of probes as proposed herein is sufficient to detect potential offsite migration of LFG and to assess the continuing success of the perimeter methane migration remediation system.

4.2 Monitoring Program

Following the installation of seven additional permanent LFG monitoring probes and the decommissioning of the 89 temporary LFG monitoring probes presented herein, the Closed Landfill will have 16 permanent LFG monitoring probes and 22 temporary LFG monitoring probes, for a total of 38.

The 16 permanent LFG monitoring probes will be monitored on a quarterly basis as required by 15A NCAC 13B .1626(4)(b)(ii). The purpose of these 16 permanent LFG monitoring probes is to assess offsite migration of LFG. The locations of these probes are shown in Table 4 below.

TABLE 4
PERMANENT LFG MONITORING PROBE LOCATIONS

Probe ID	Northing	Easting
M-1	788573.91	2125987.89
M-2	788372.83	2126336.14
M-3	788114.48	2126692.67
M-4	787958.21	2126964.38
M-5	787655.77	2127010.23
M-6	787150.80	2126844.90
M-7	787646.88	2125709.90
M-8	787758.10	2125711.45
M-9	788098.81	2125715.17
M-19*	786904	2125718
M-20*	787062	2125715
M-21*	787219	2125714
M-22*	787433	2125714
M-23*	787936	2125709
M-24*	786962	2126766
M-25*	786720	2126684

* These proposed probe locations are approximate and will be adjusted in the field as necessary to accommodate site conditions.

The remaining 22 temporary LFG monitoring probes will be monitored monthly for six months. The purpose of these 22 probes is to monitor offsite migration and to assess the effectiveness of the perimeter methane migration remediation system.

The 22 probes will be monitored for six months and the data will be evaluated. The temporary LFG monitoring probes that demonstrate a decreasing methane trend and are below the regulatory limit of methane for three consecutive months will be decommissioned in the same manner as the other temporary LFG monitoring probes. Temporary LFG monitoring probes that do not have three consecutive months of readings below the regulatory limit will continue to be monitored monthly until there are three consecutive months of readings below the regulatory limit. At that time, they will be decommissioned and abandoned in-place.

DRAWN BY: JLM DATE: 5/11/05 FILE NAME: 02199312.01

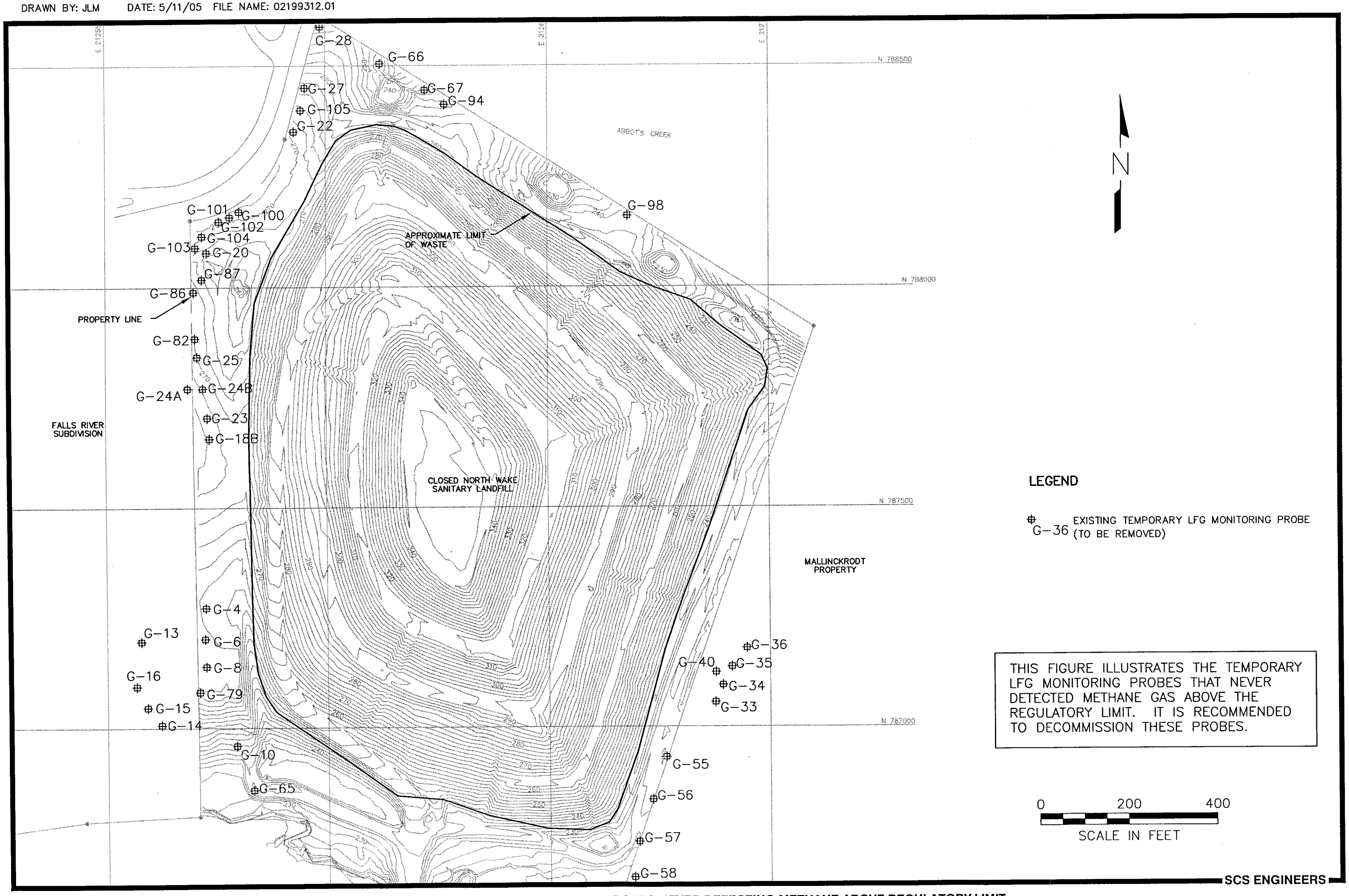

FIGURE 1 - TEMPORARY LFG MONITORING PROBES NEVER DETECTING METHANE ABOVE REGULATORY LIMIT

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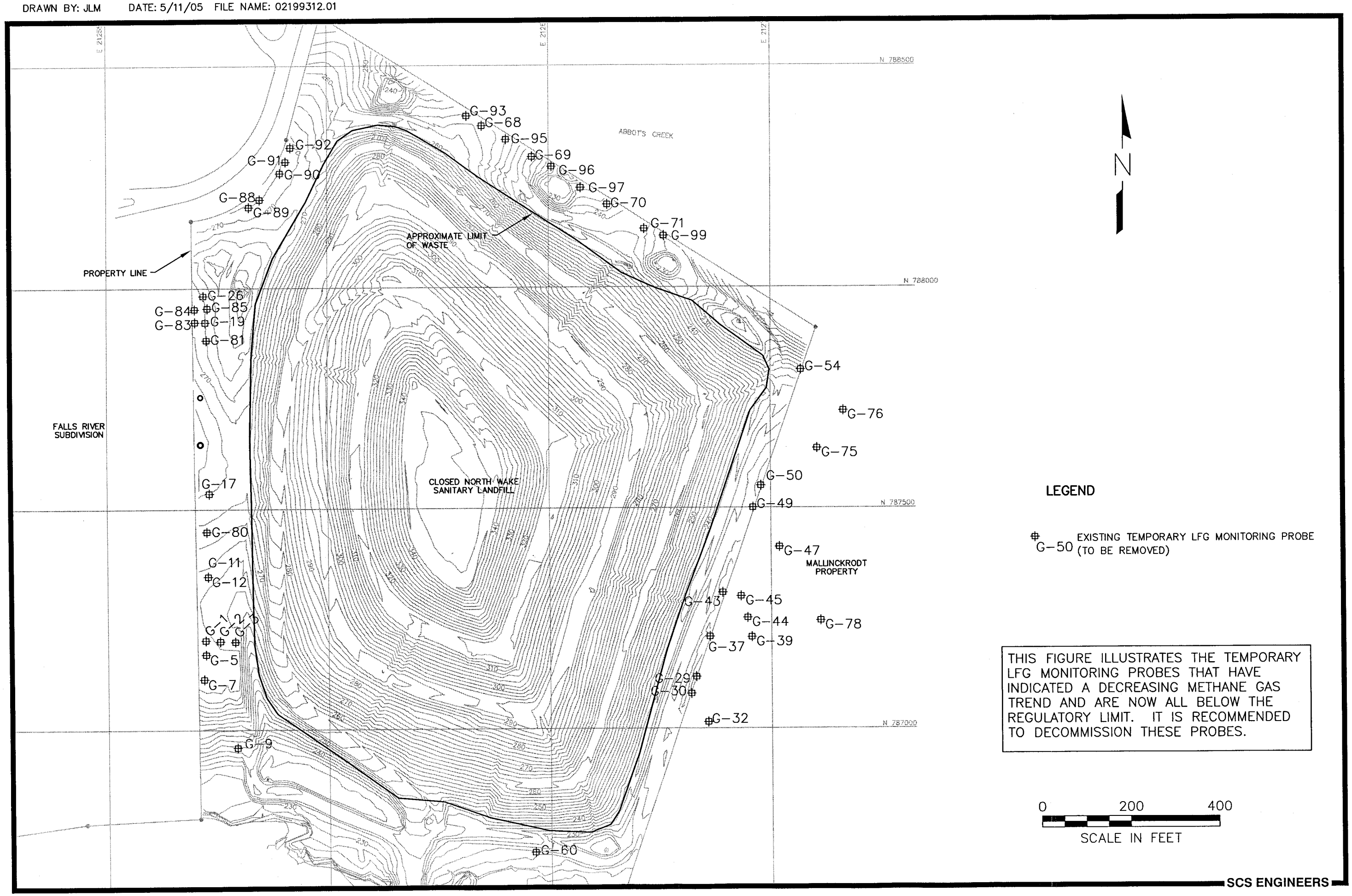

FIGURE 2 - TEMPORARY LFG MONITORING PROBES DEMONSTRATING DECREASING METHANE TREND

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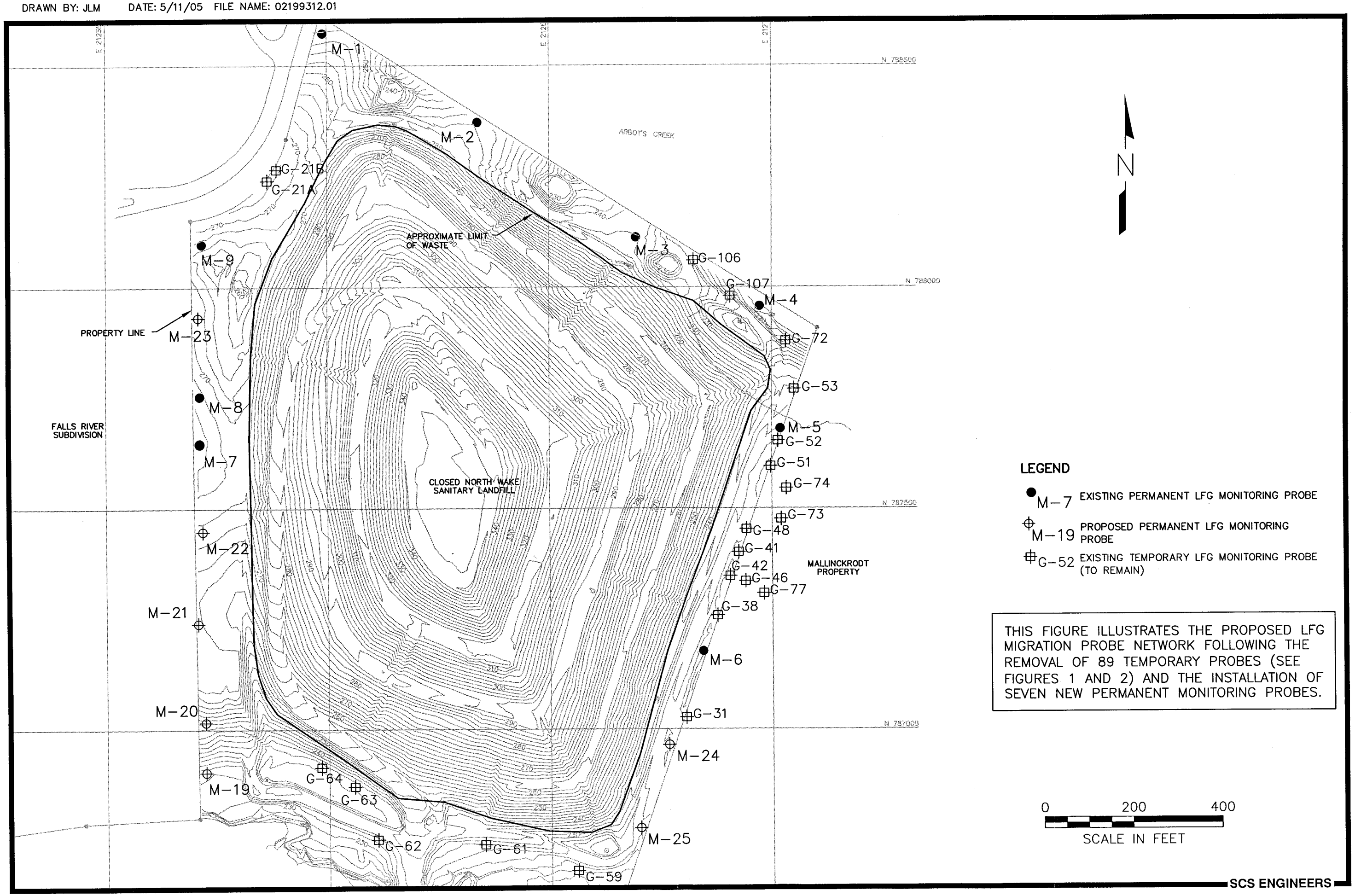


FIGURE 3 - PROPOSED LFG MONITORING PROBE NETWORK

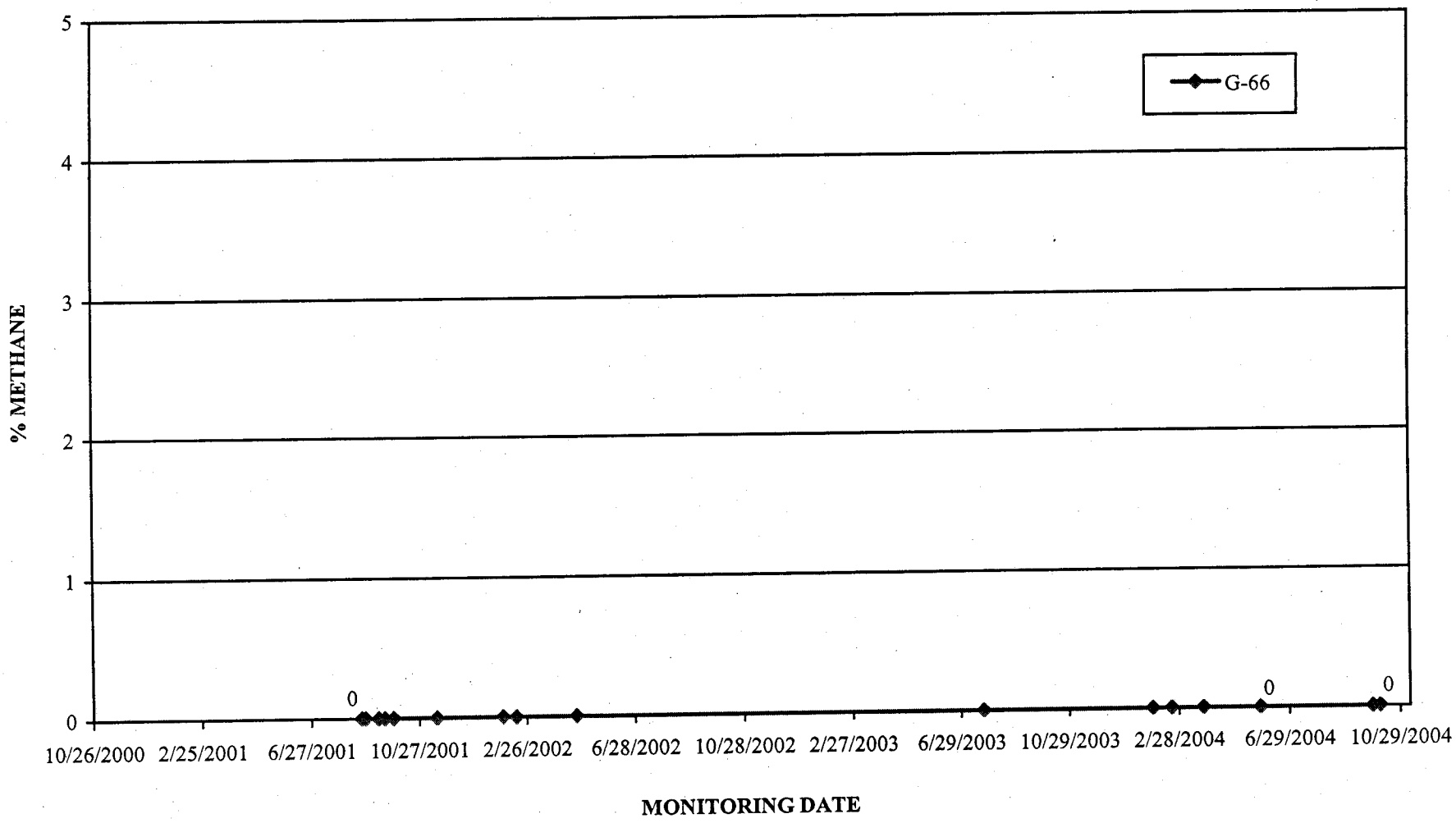
APPENDIX A

DRAWING (Under Separate Cover)

APPENDIX B

MONITORING DATA FOR TEMPORARY LFG MONITORING PROBES NEVER DETECTING METHANE ABOVE THE REGULATORY LIMIT

METHANE MIGRATION TRENDS IN TEMPORARY LFG MONITORING PROBES
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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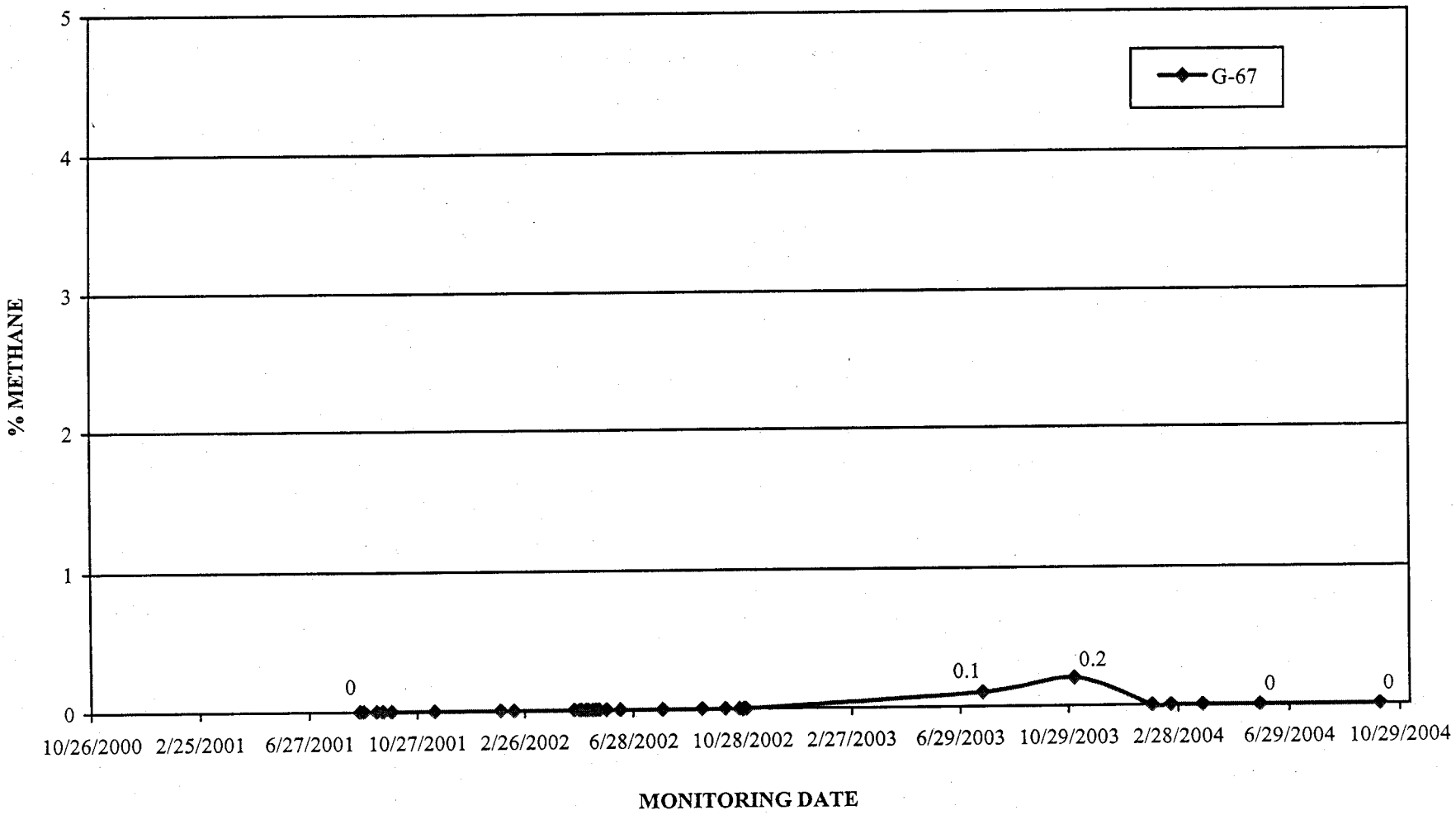
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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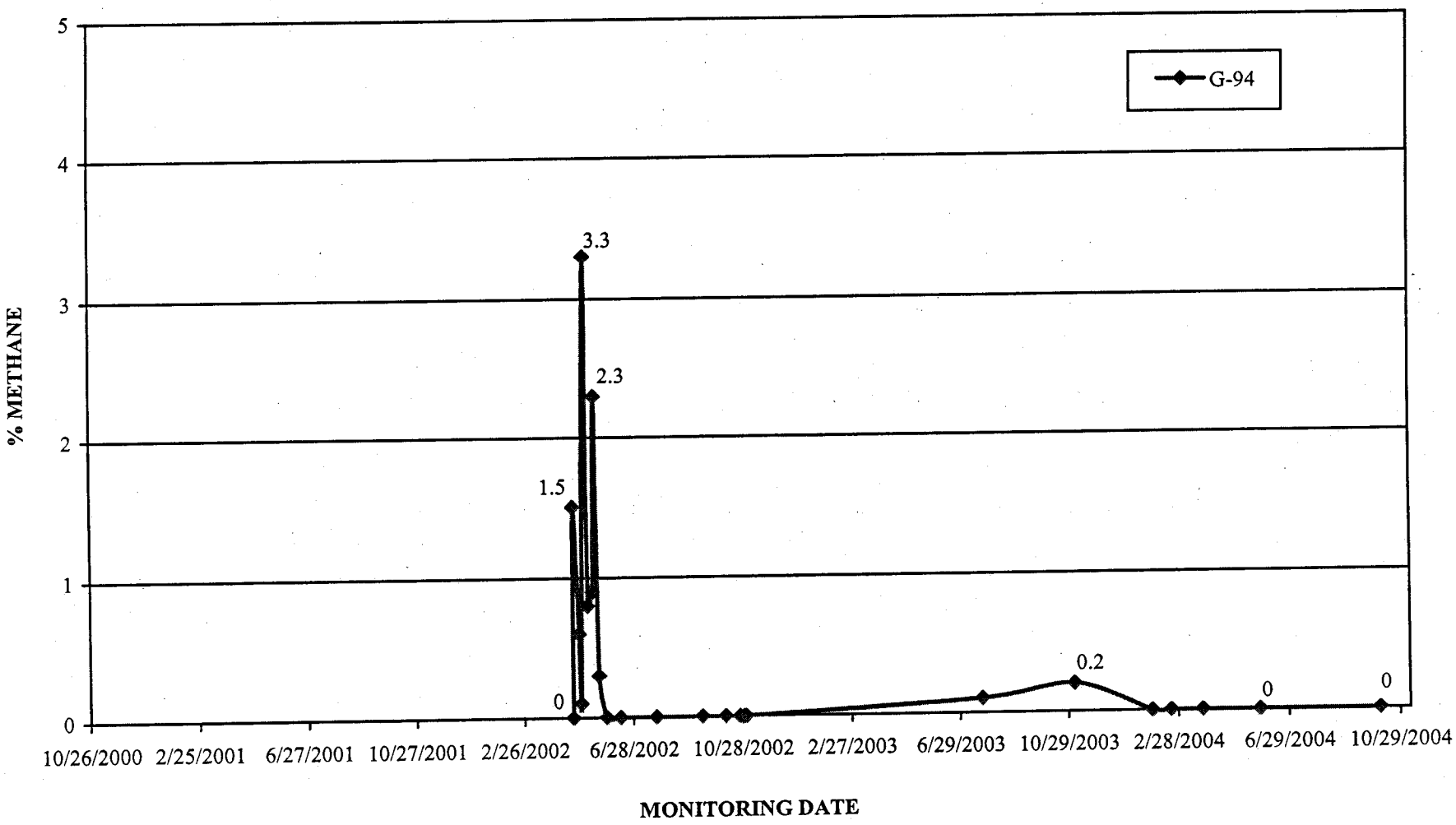
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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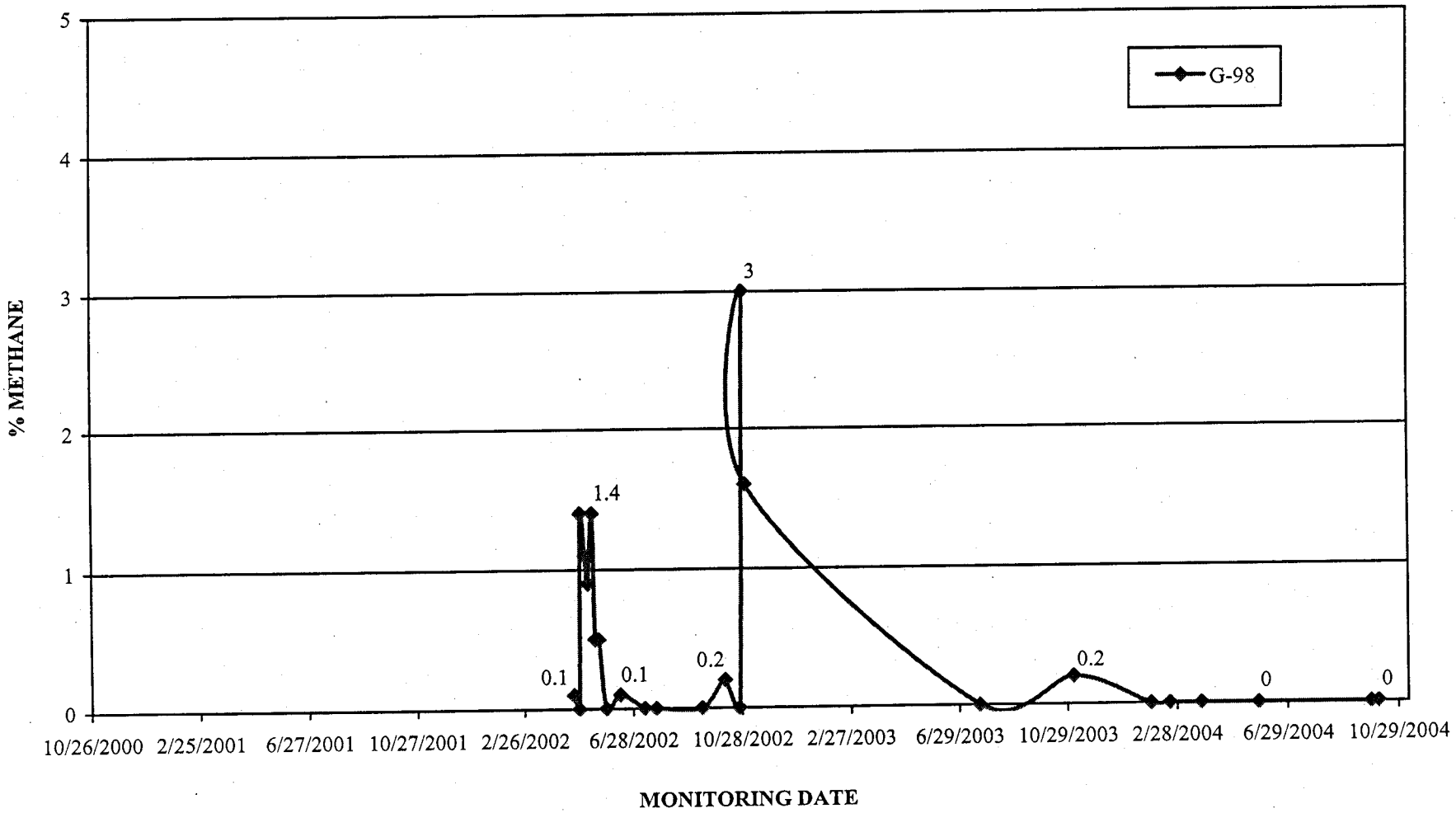
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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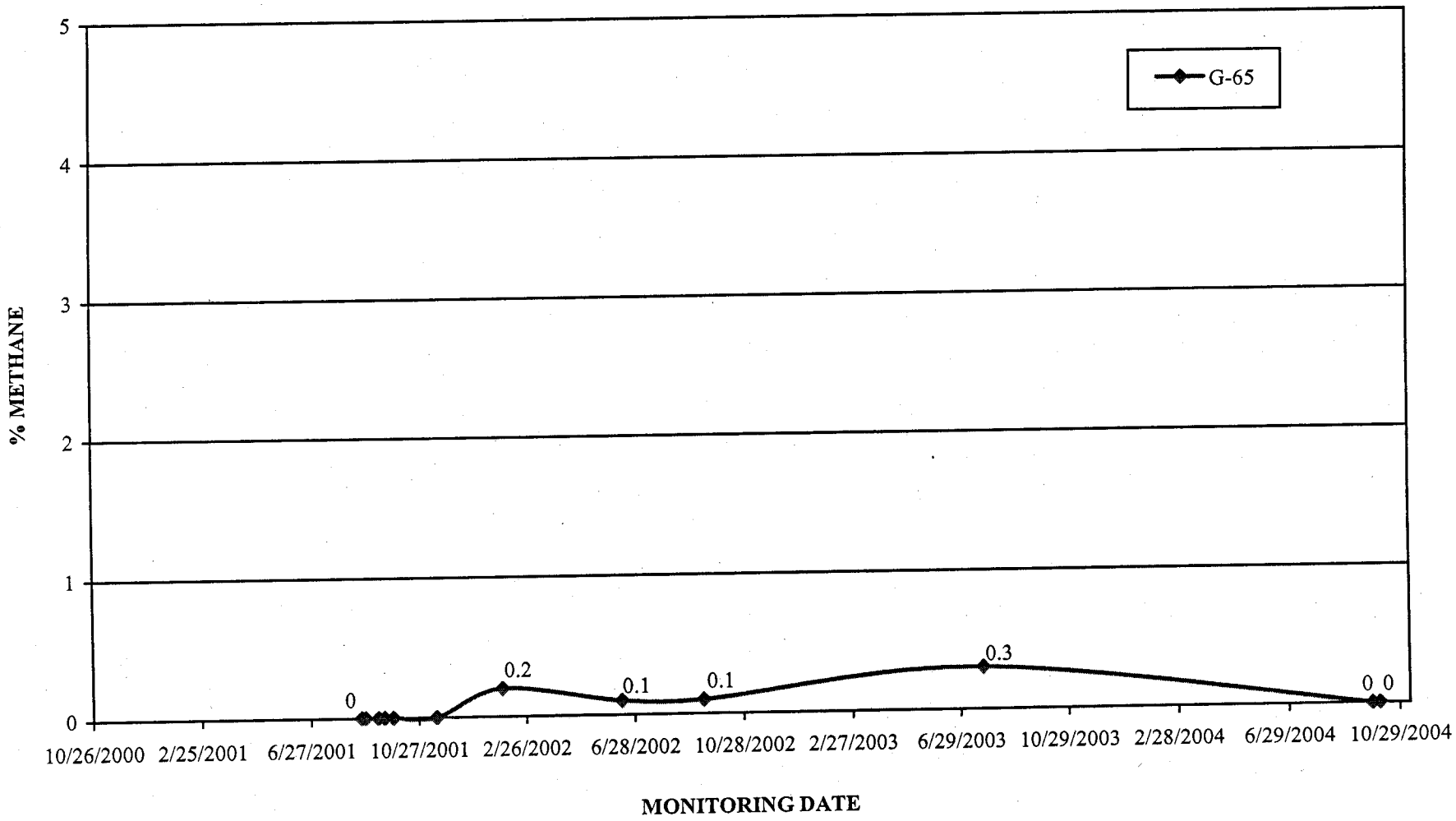
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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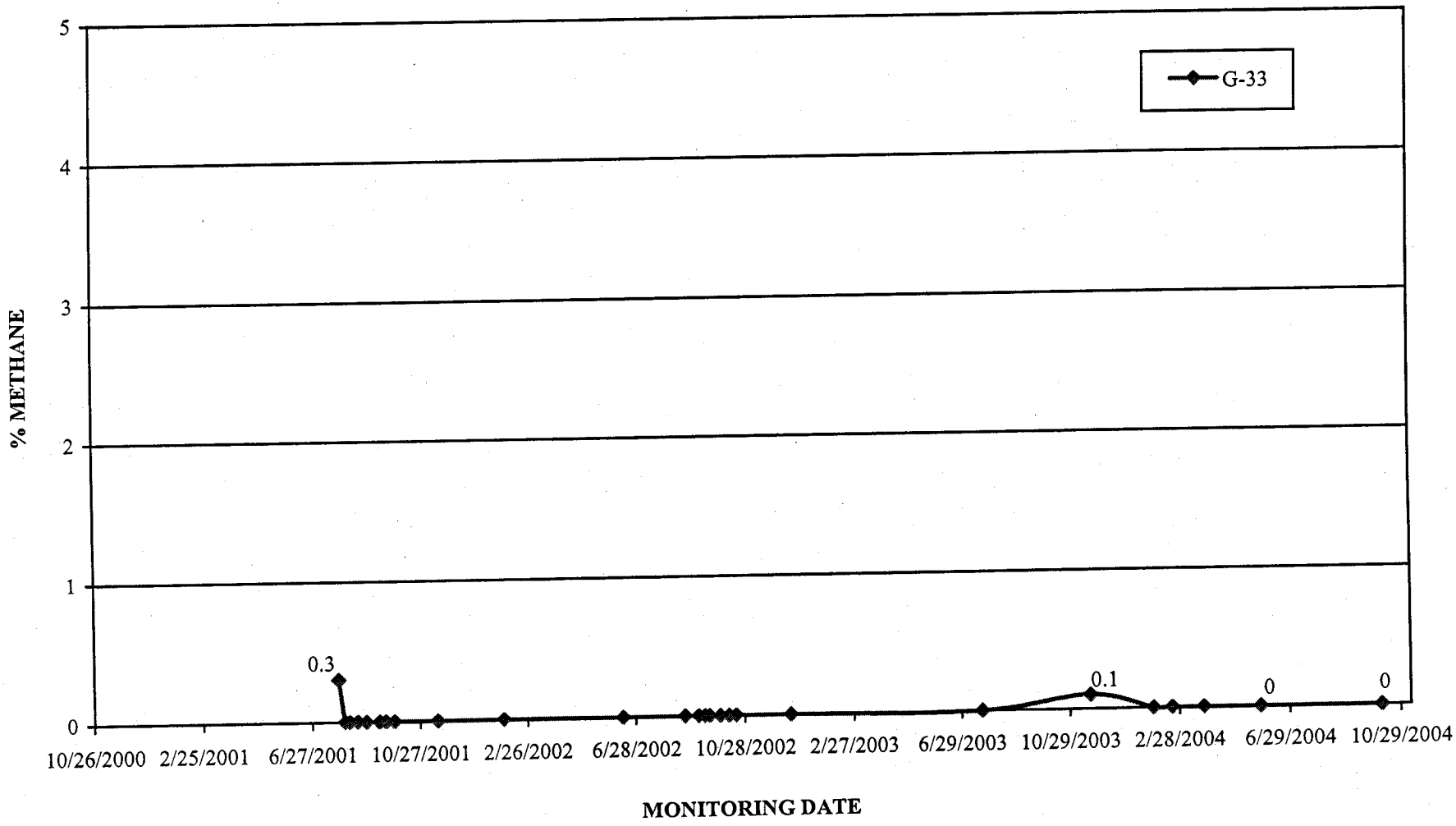
METHANE MIGRATION TRENDS IN TEMPORARY LFG MONITORING PROBES
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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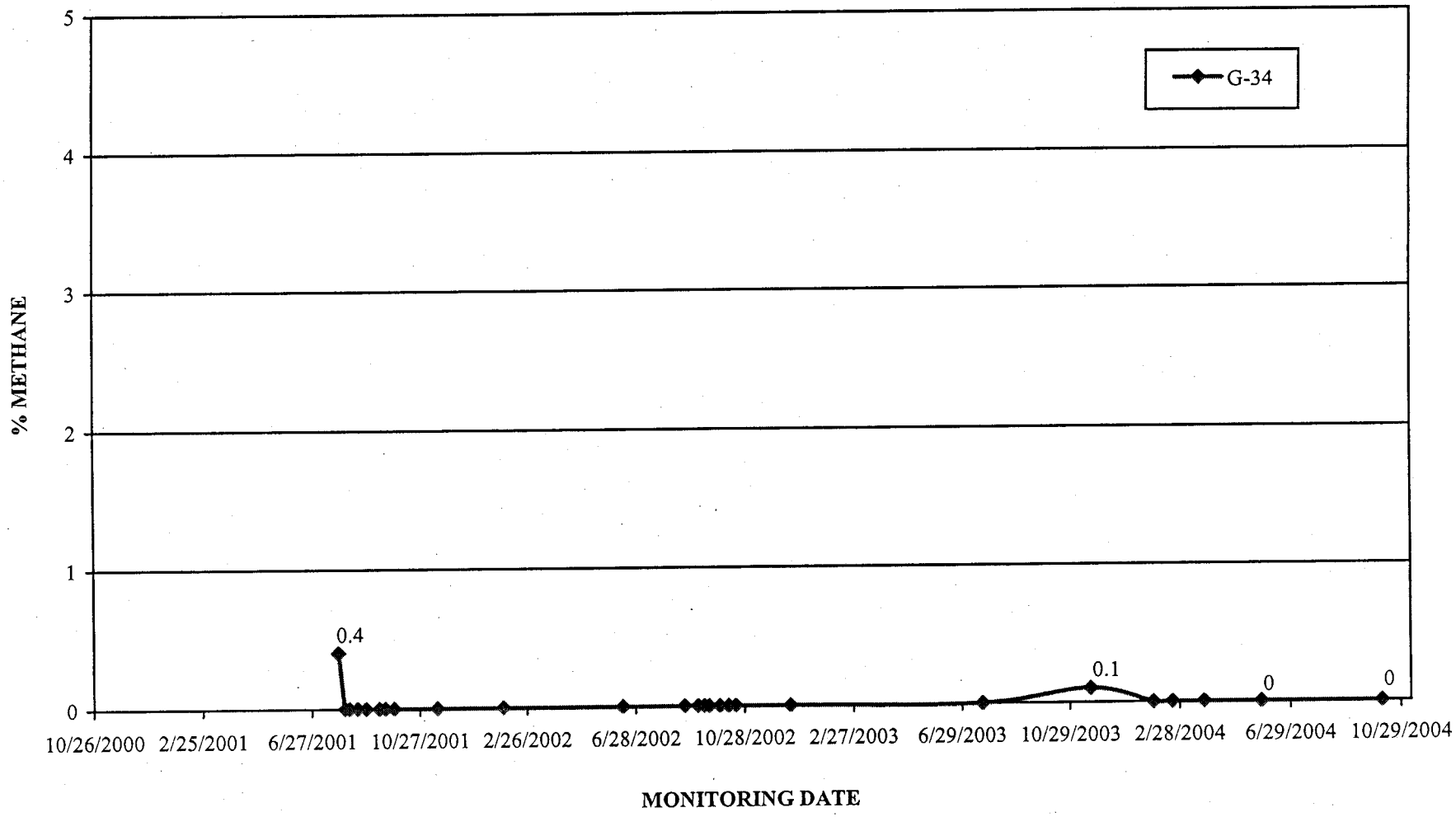
METHANE MIGRATION TRENDS IN TEMPORARY LFG MONITORING PROBES
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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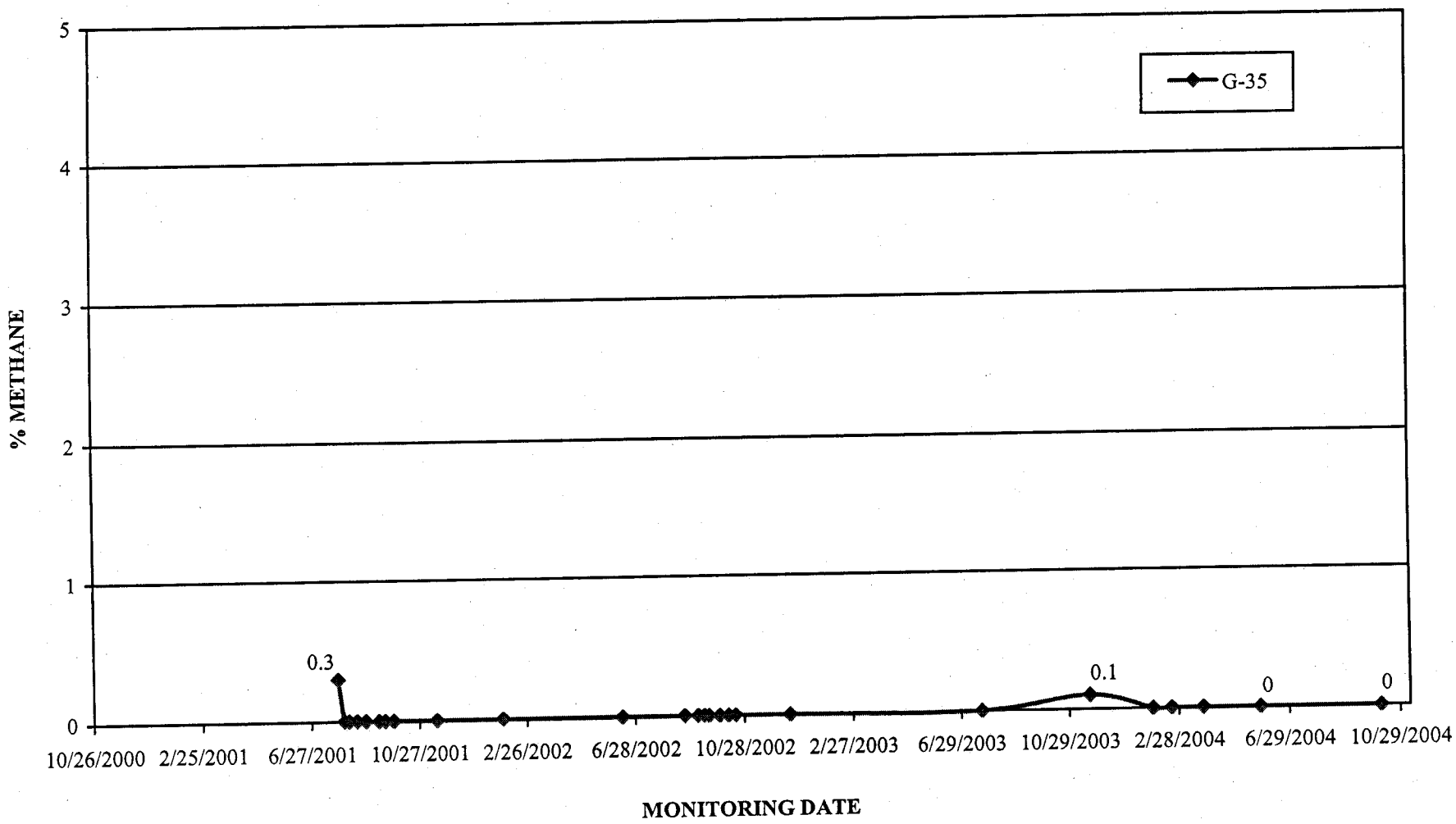
METHANE MIGRATION TRENDS IN TEMPORARY LFG MONITORING PROBES
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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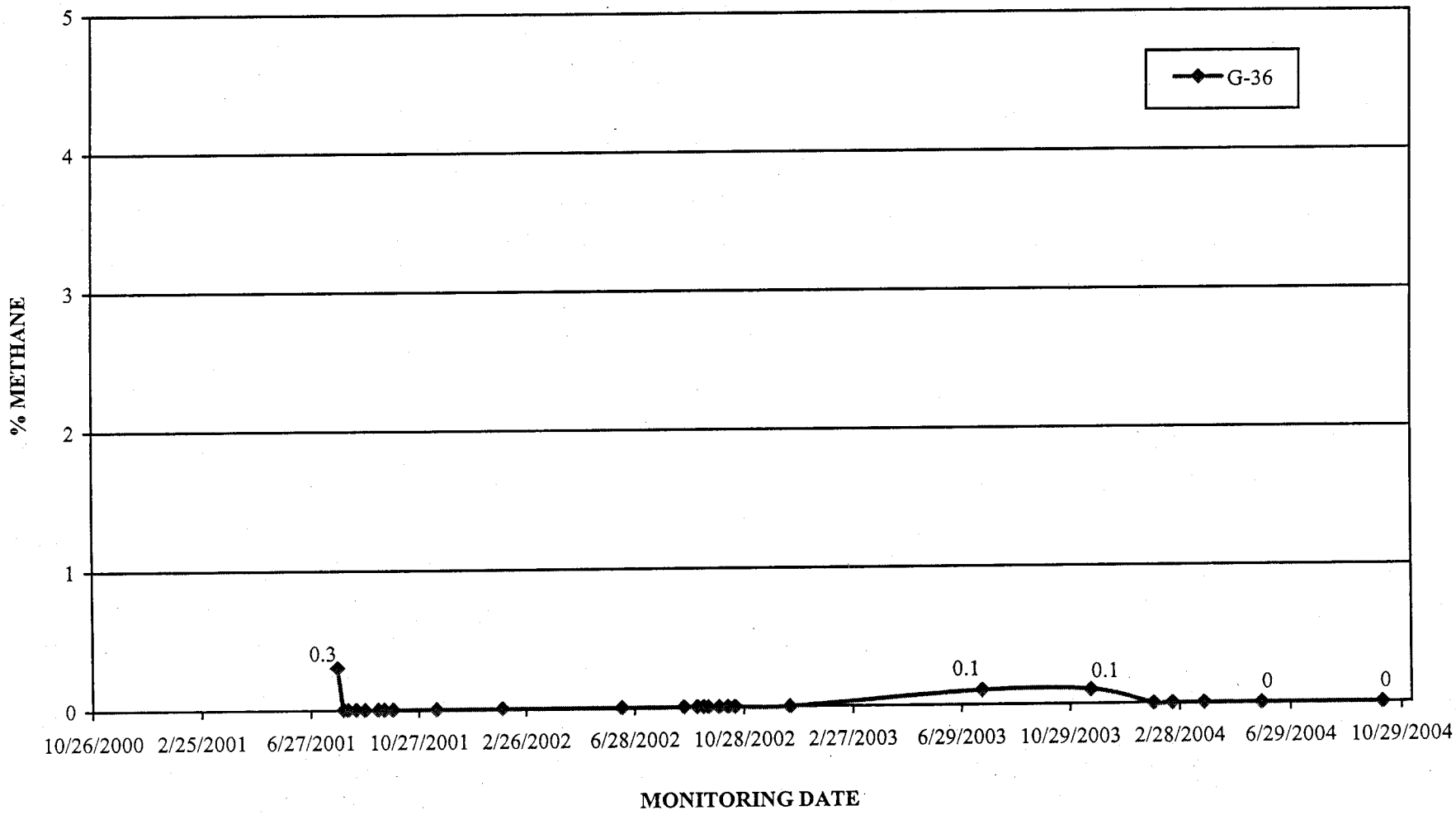
METHANE MIGRATION TRENDS IN TEMPORARY LFG MONITORING PROBES
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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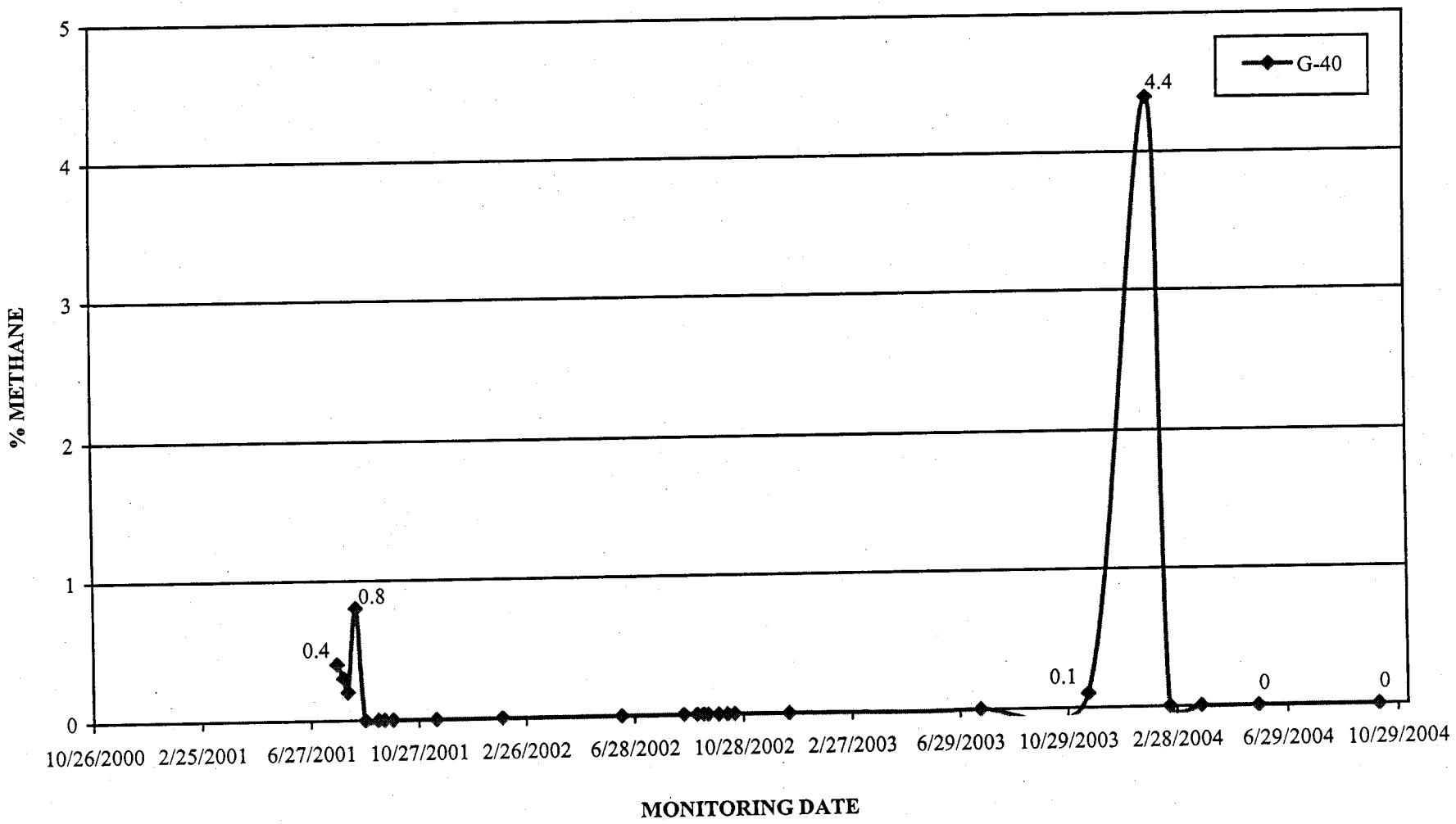
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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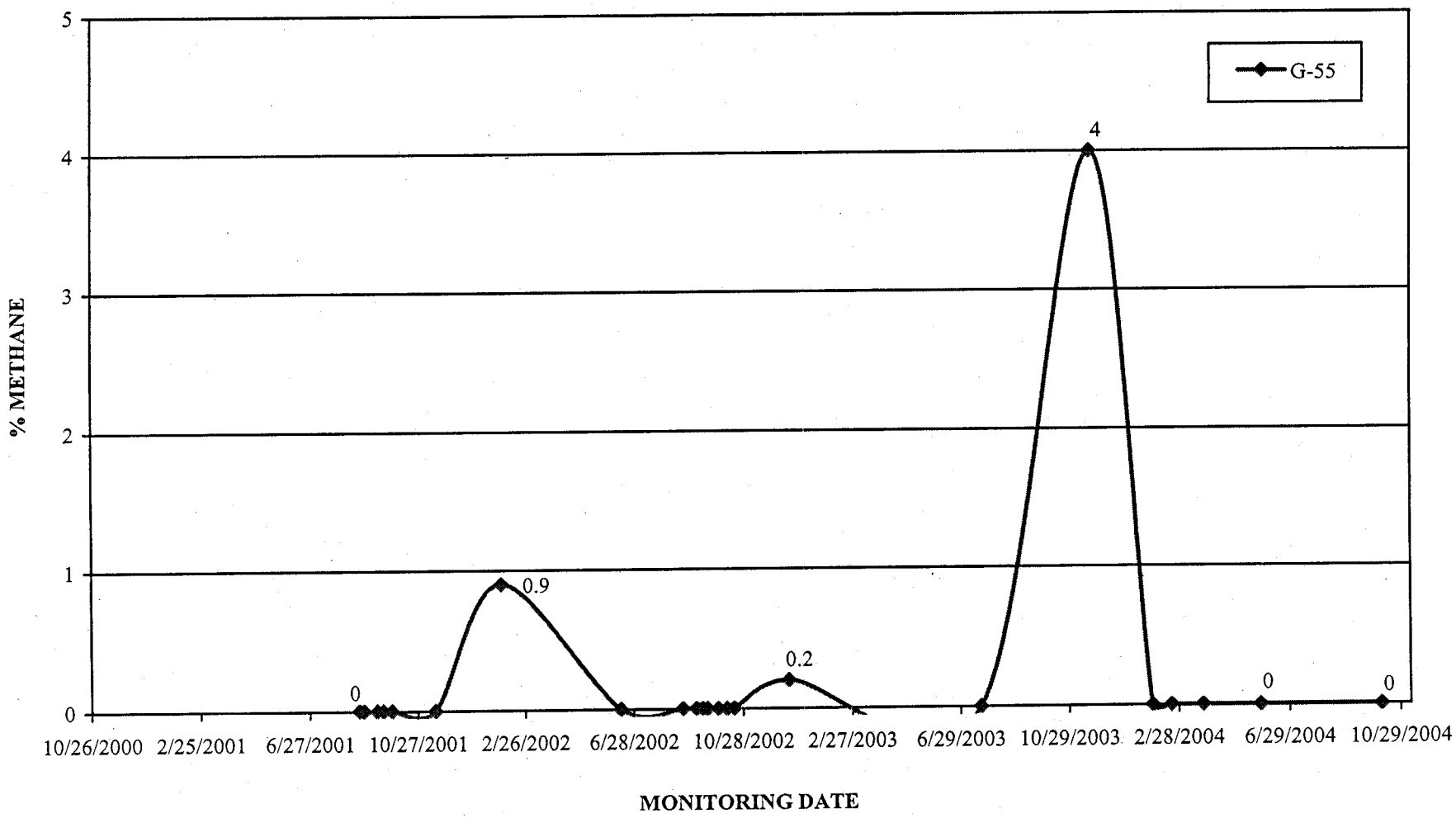

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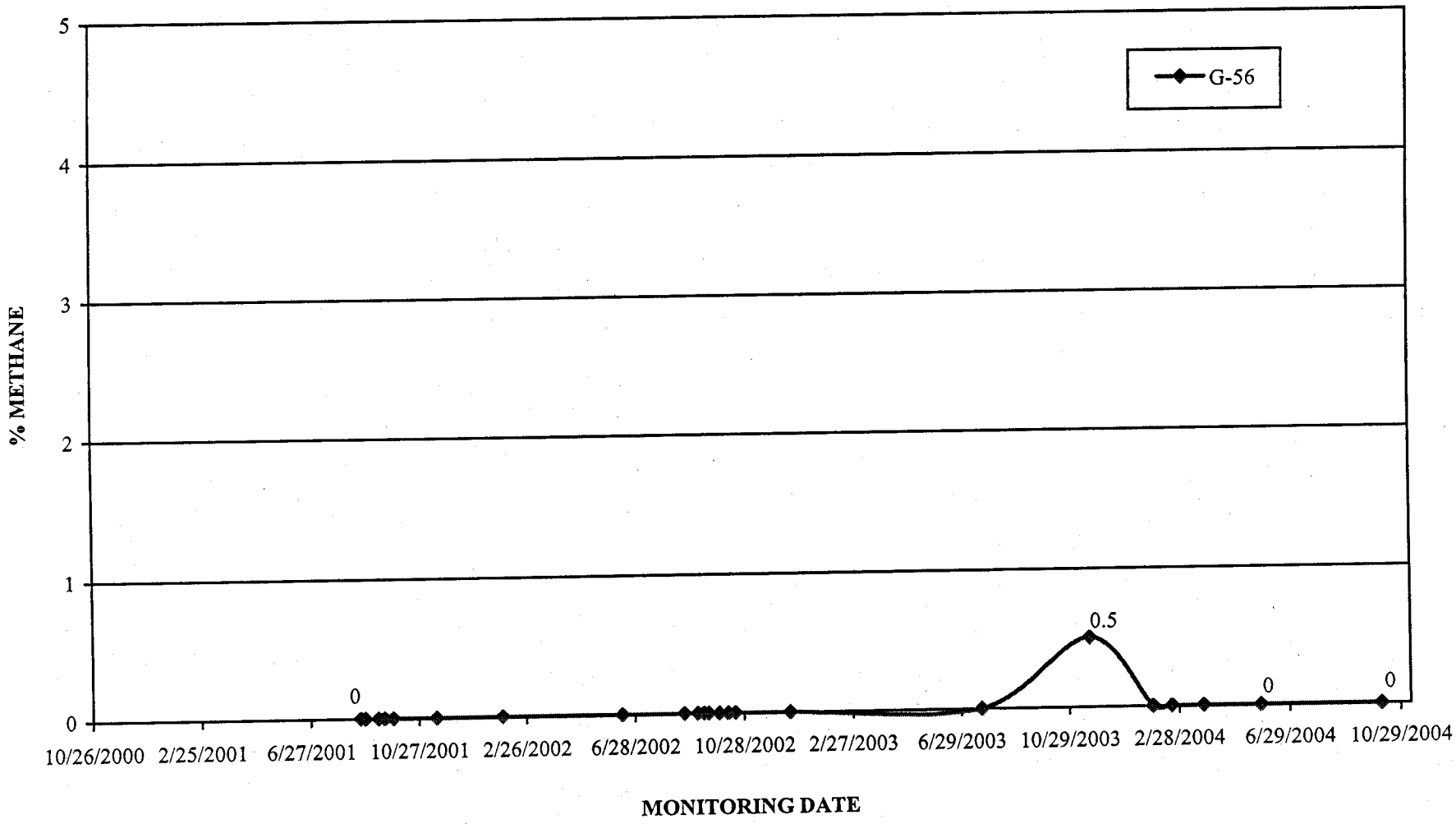

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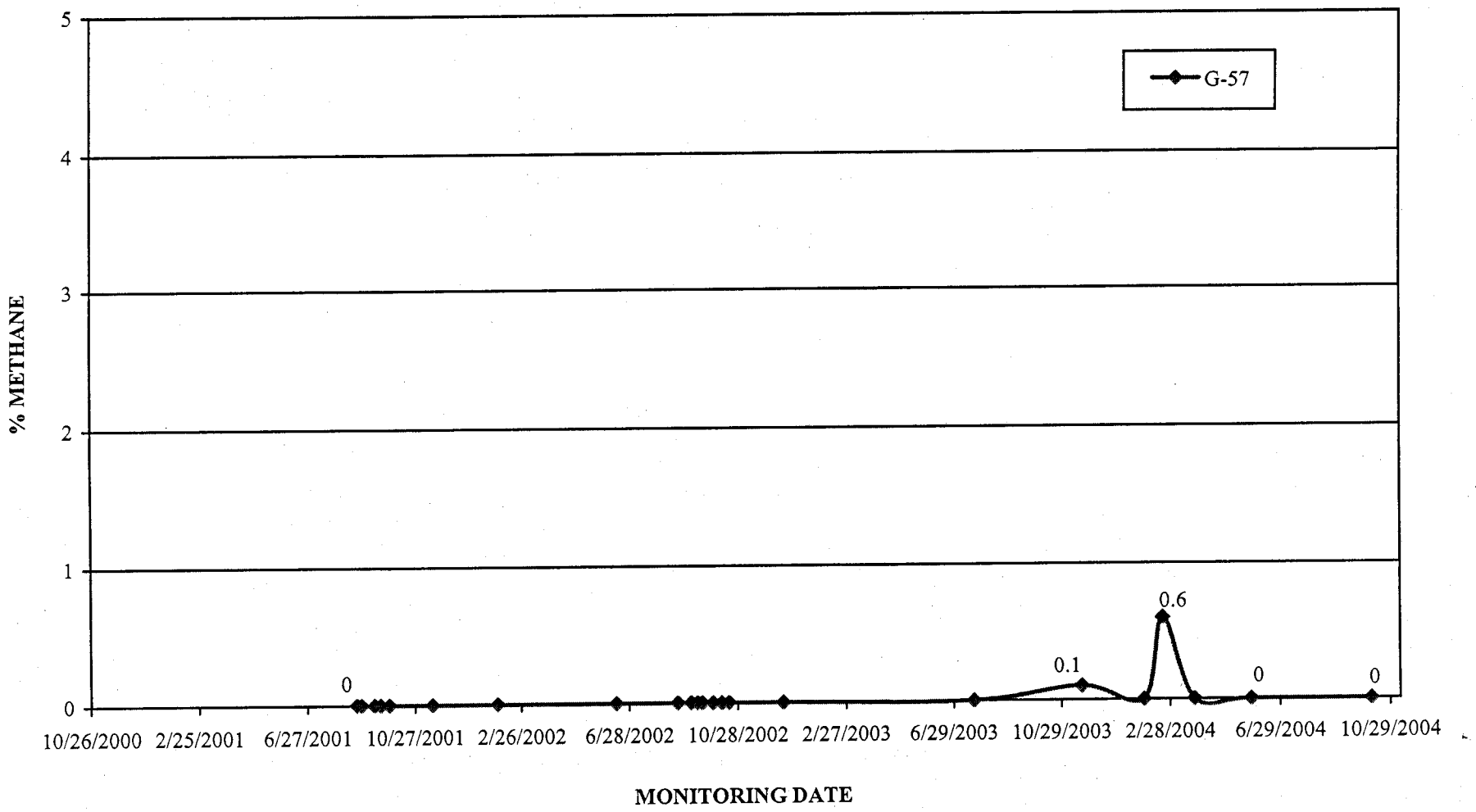

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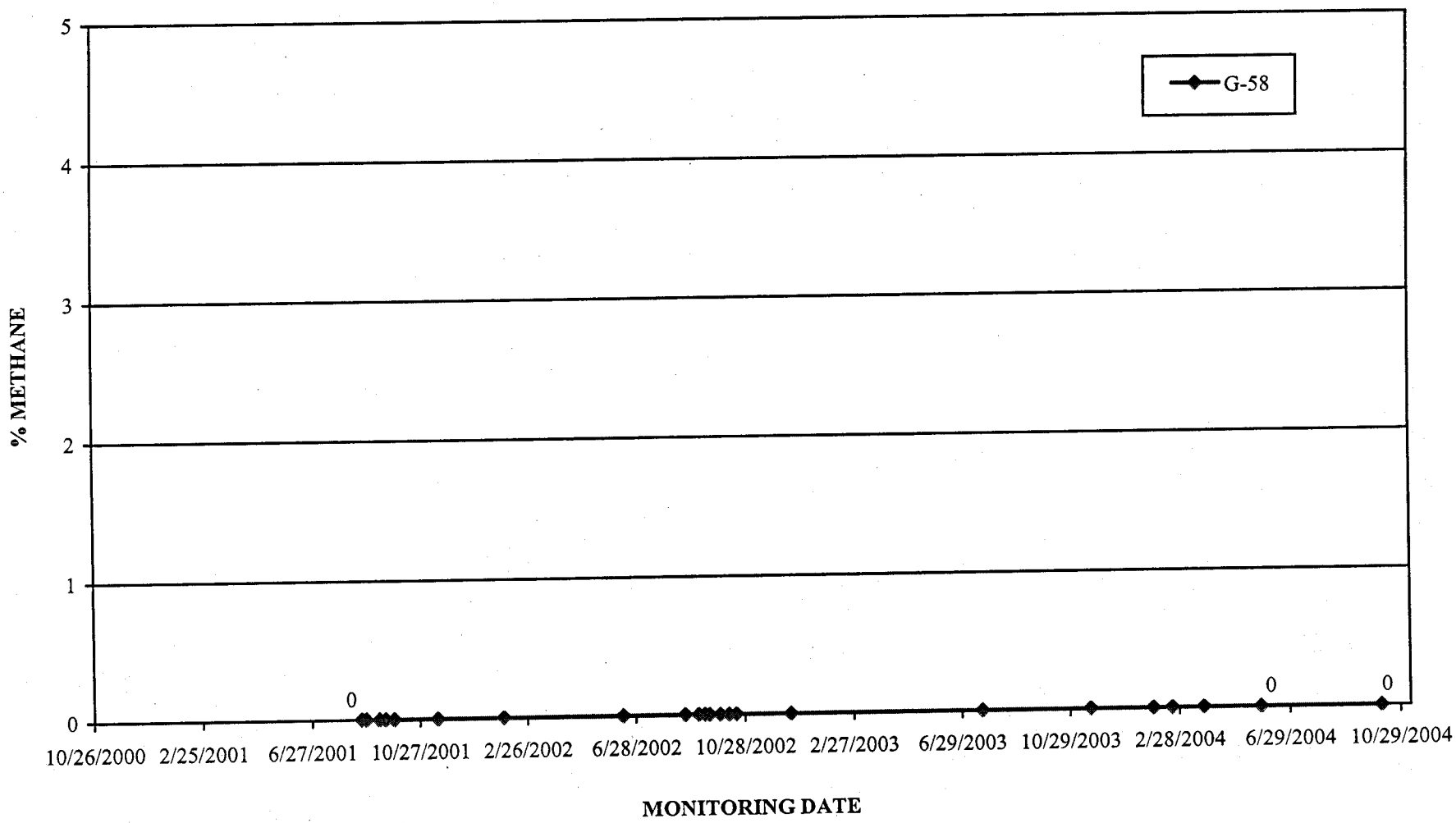

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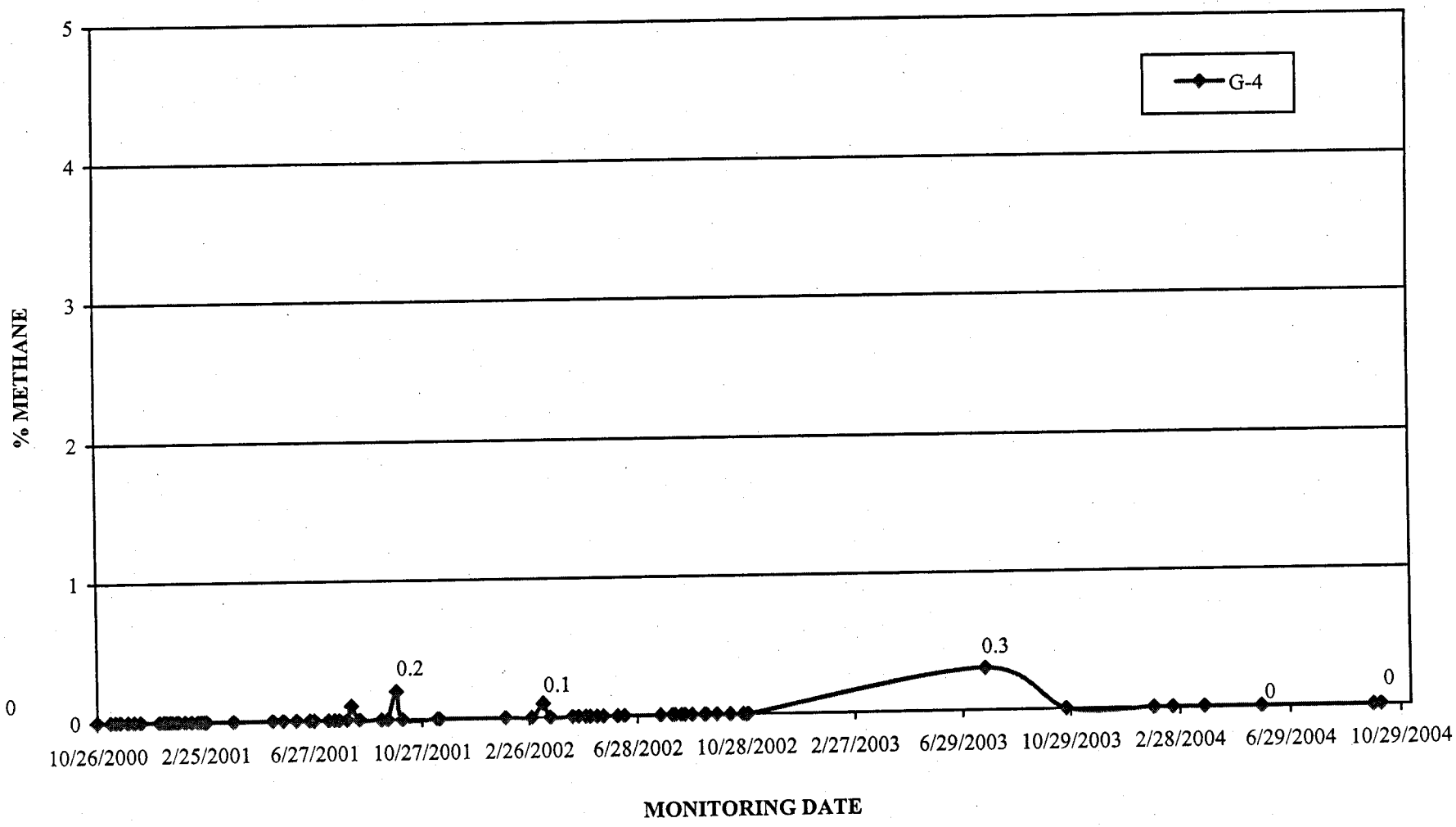

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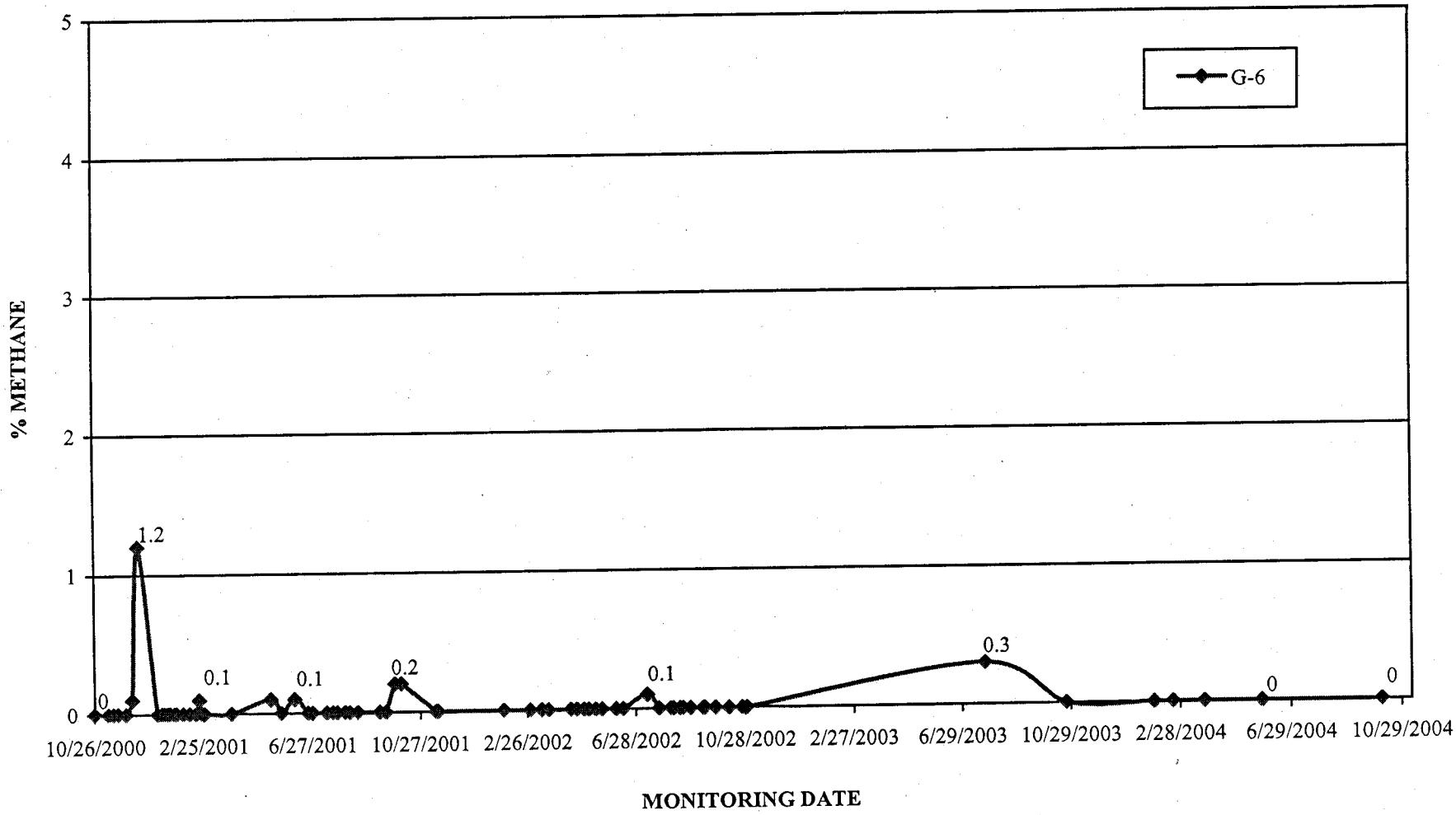

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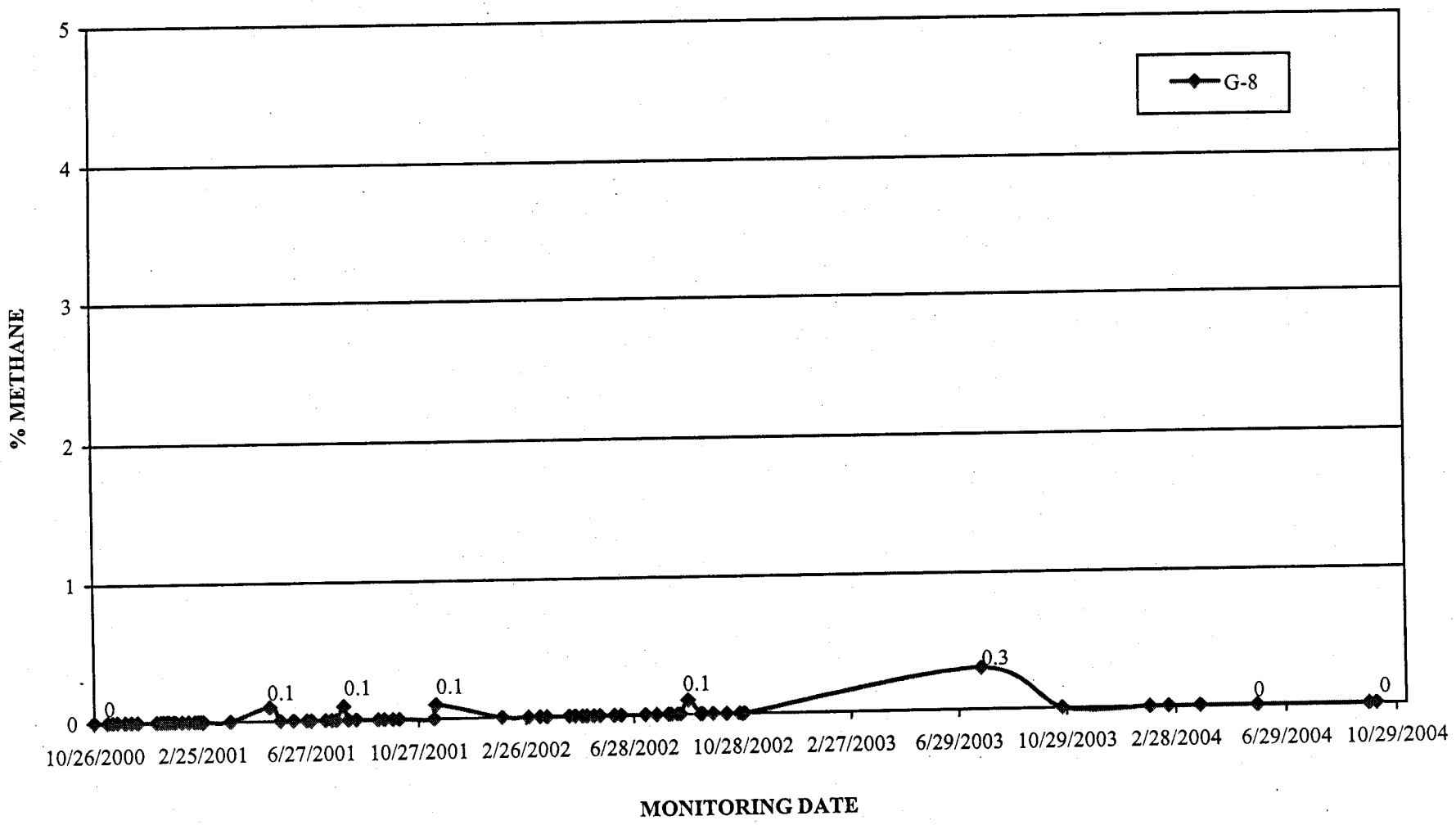

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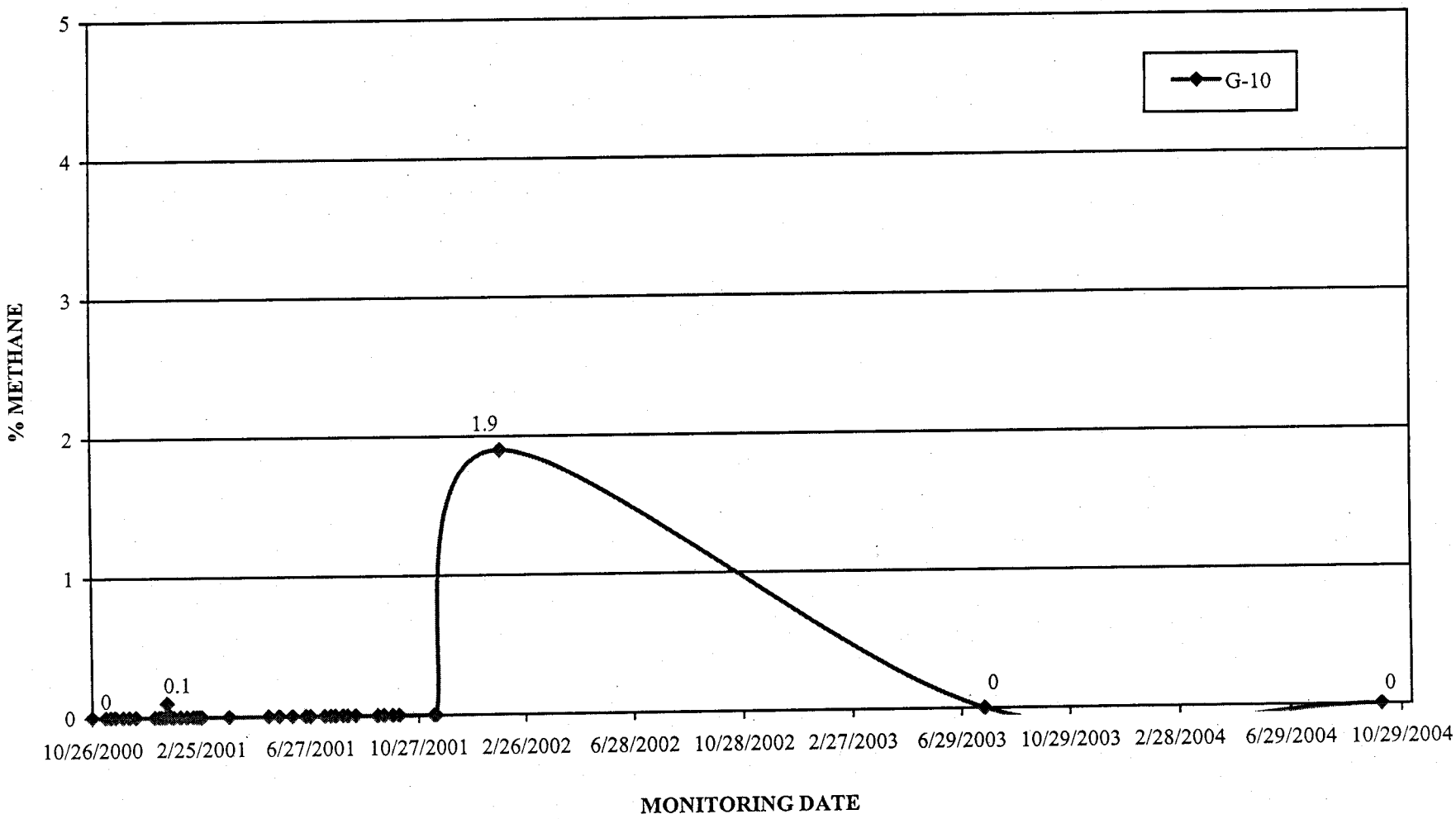

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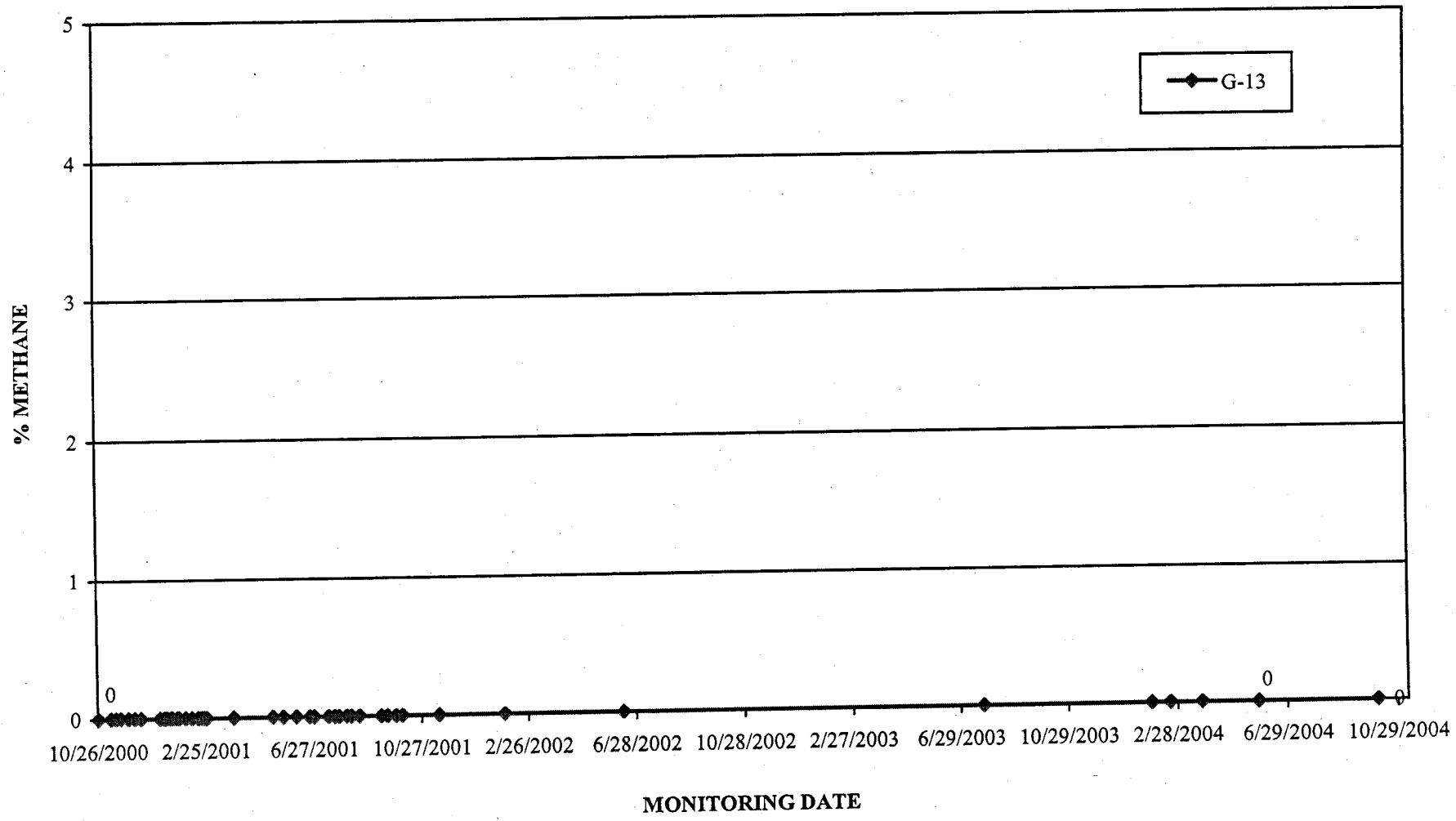

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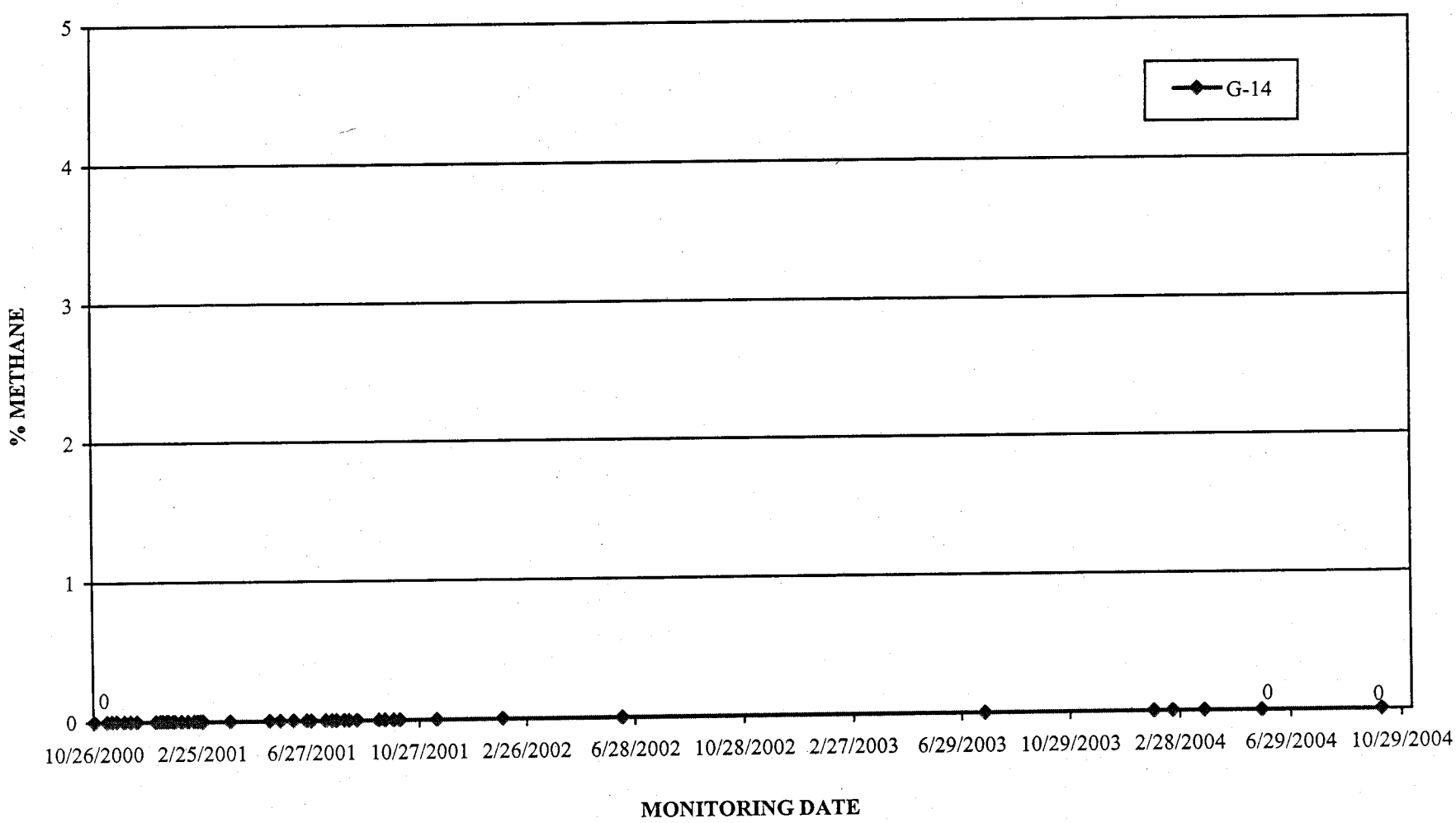

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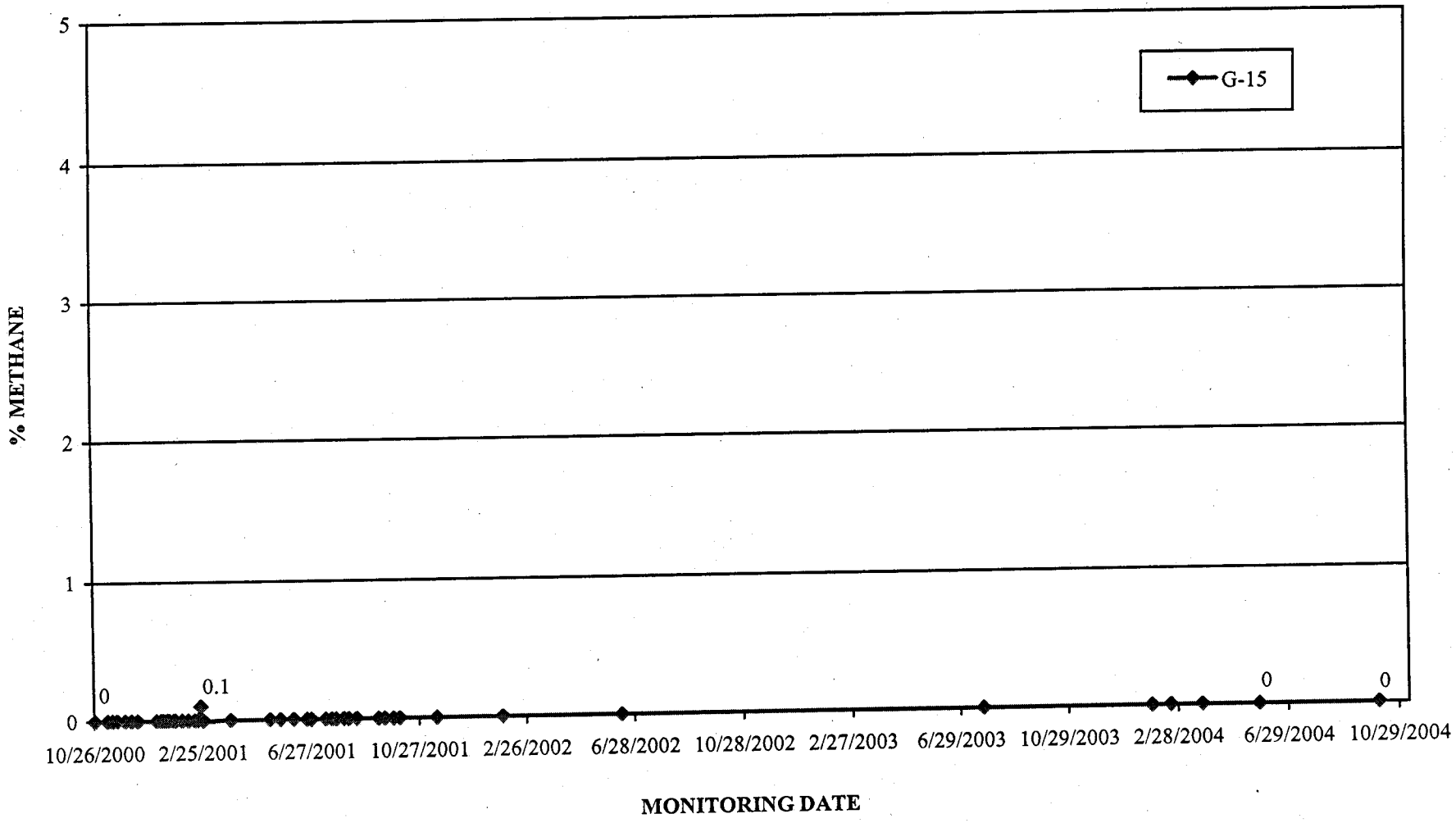

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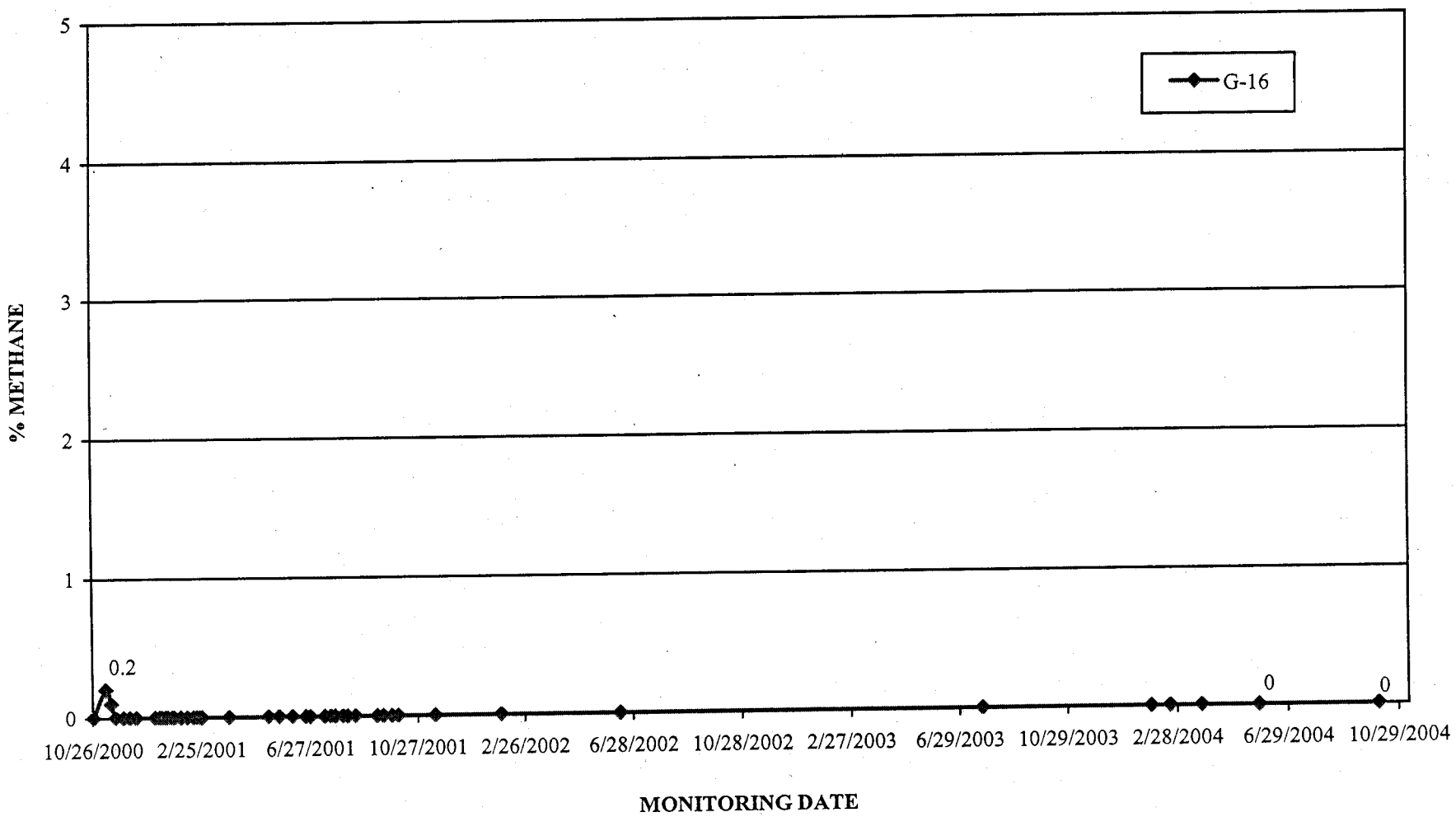

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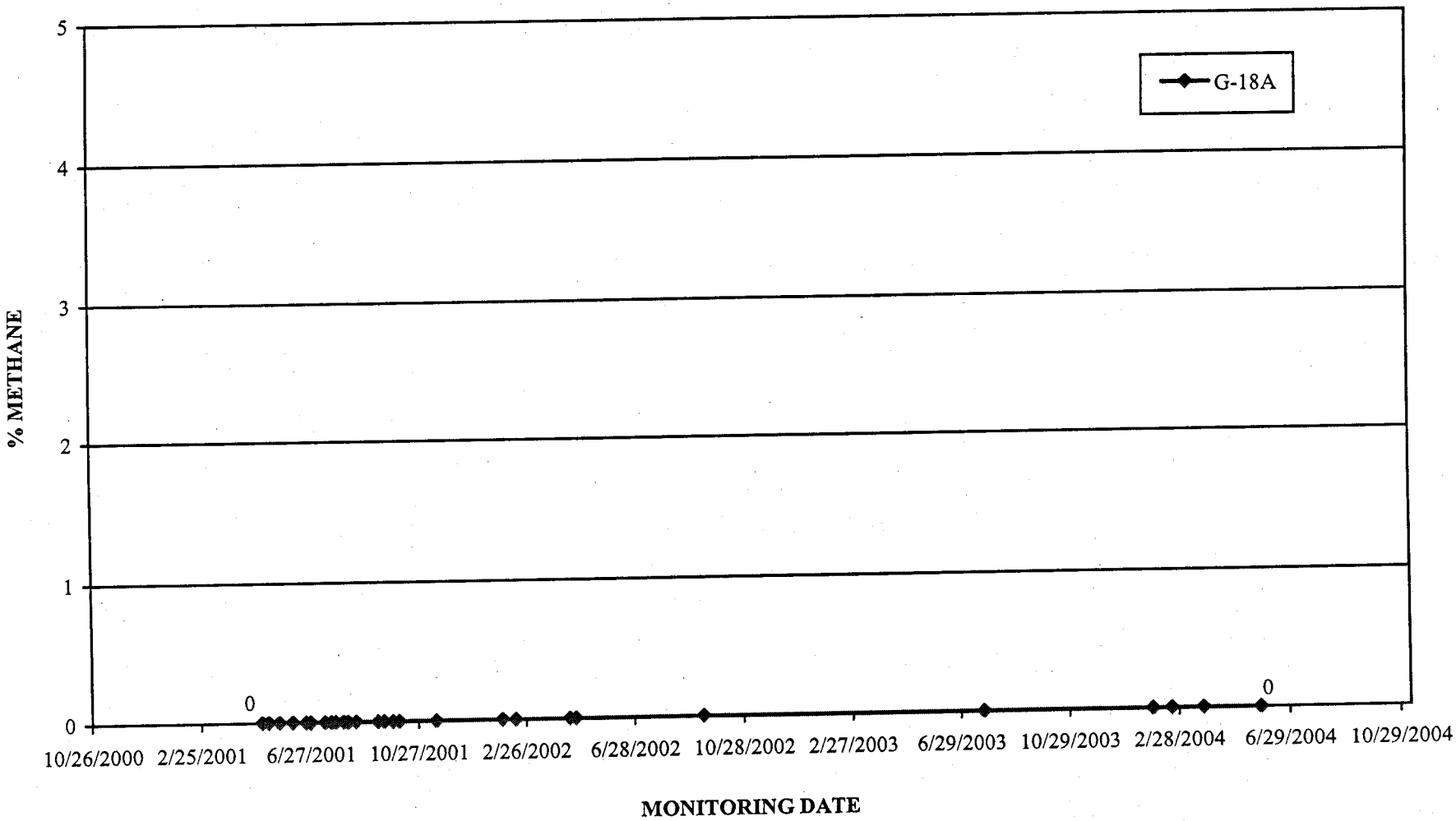

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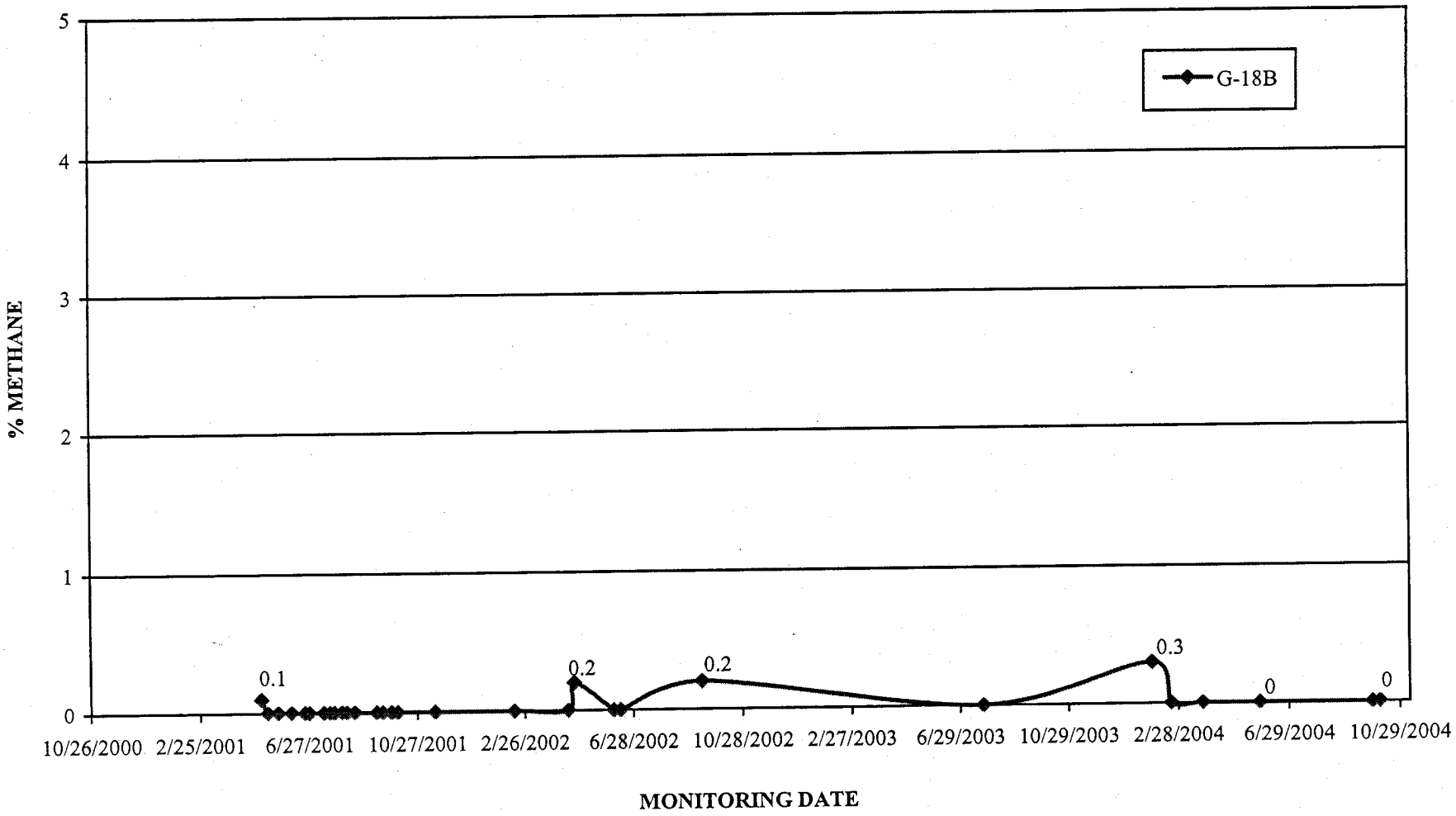

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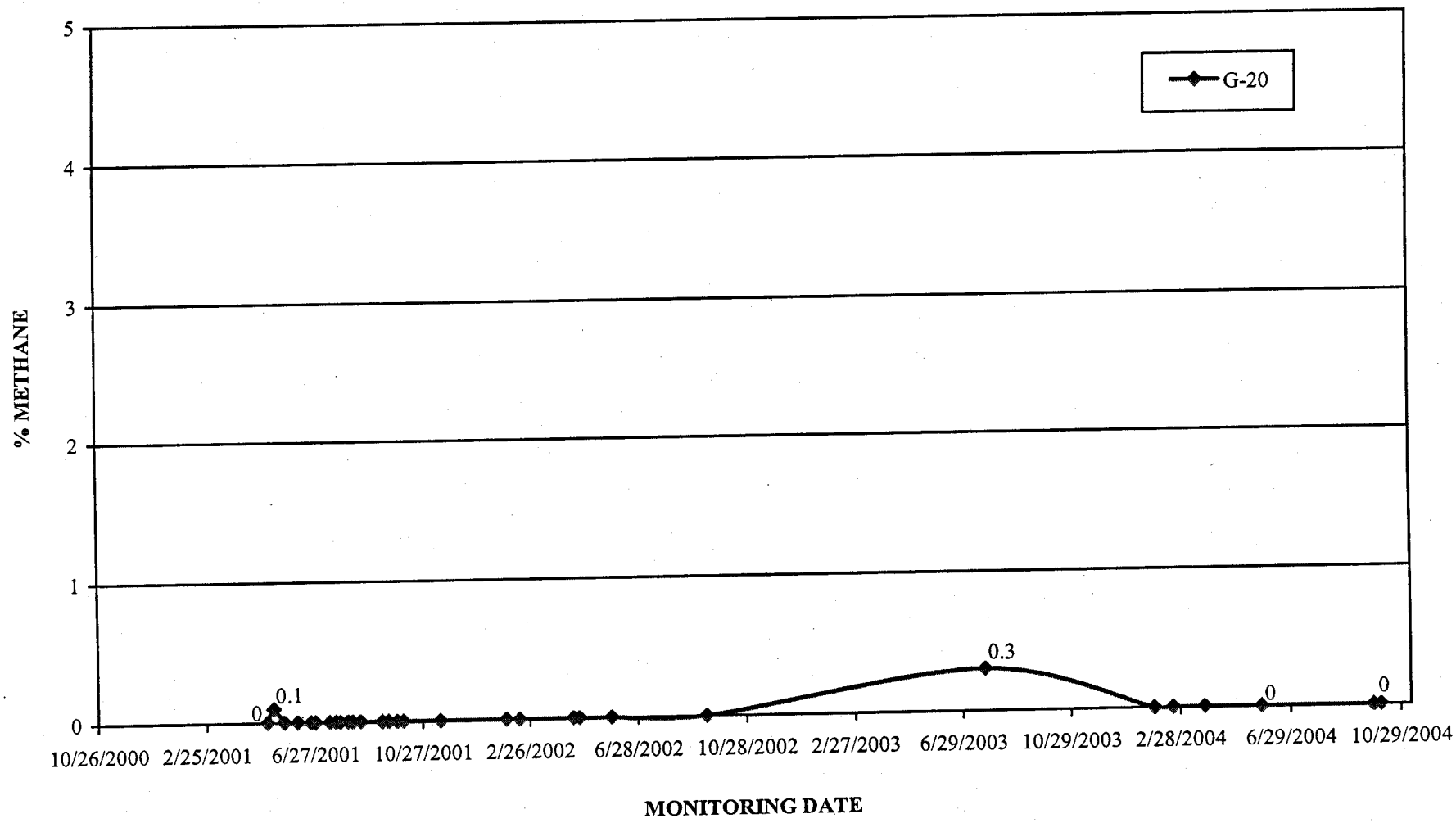

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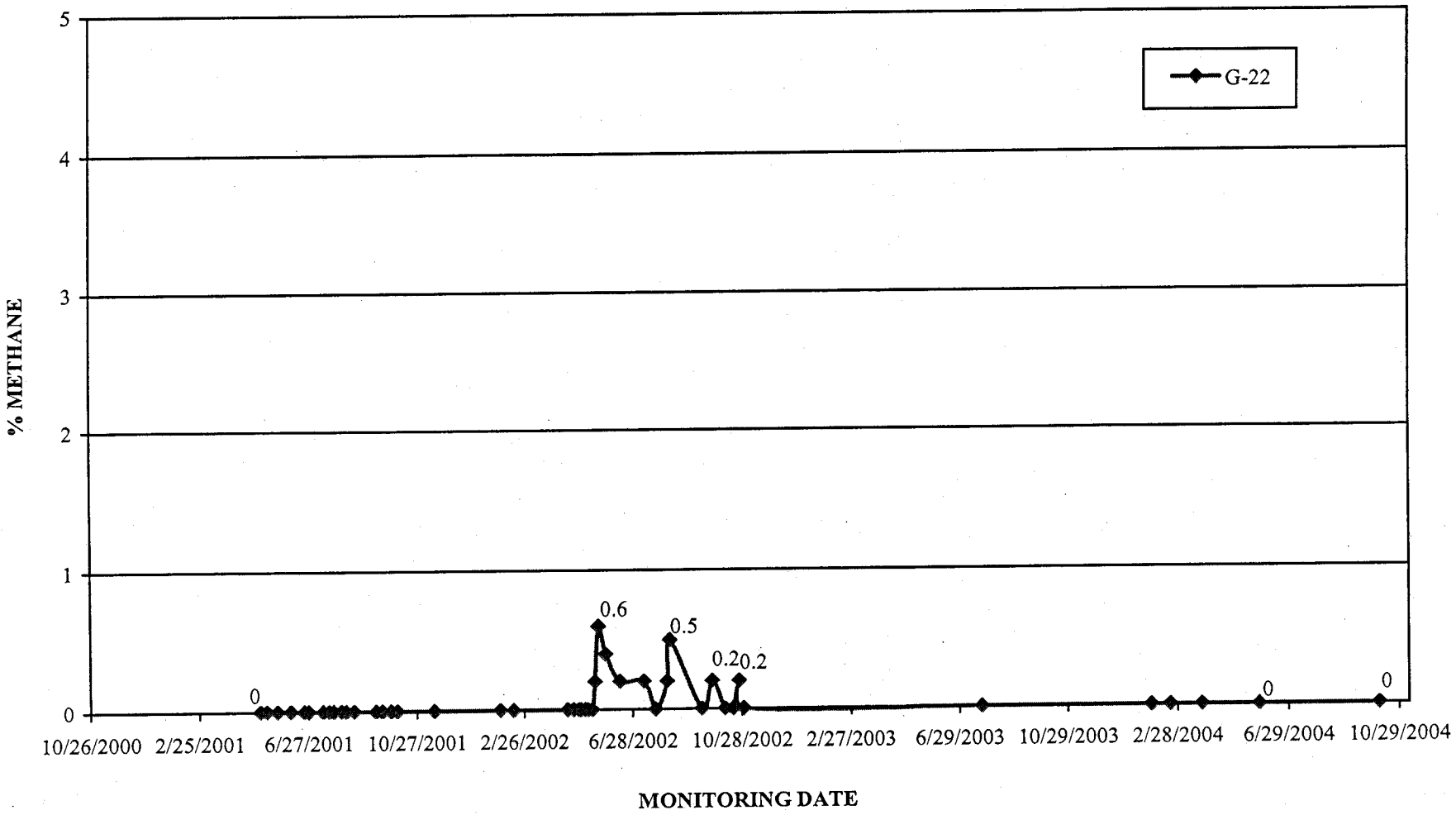

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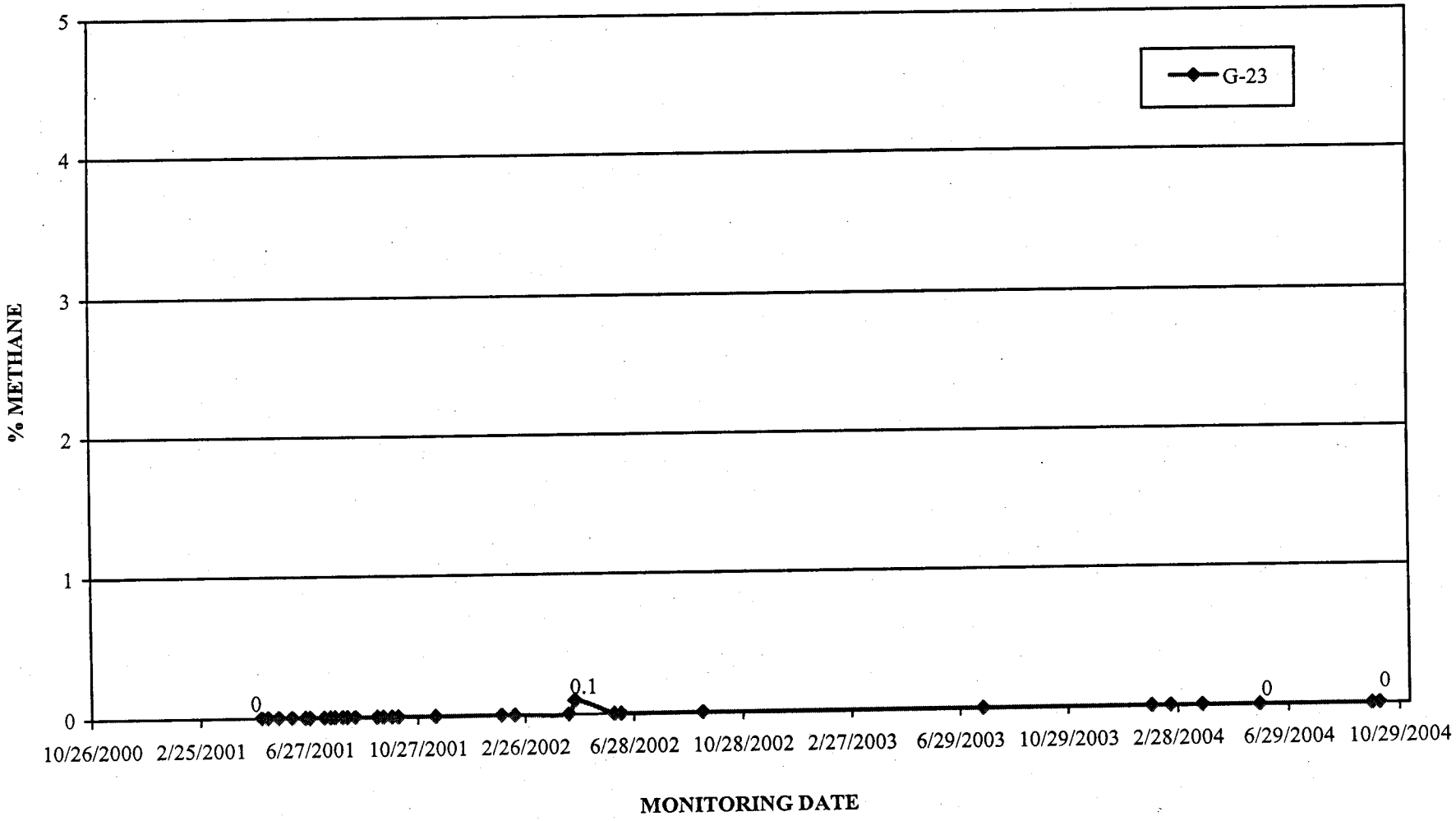

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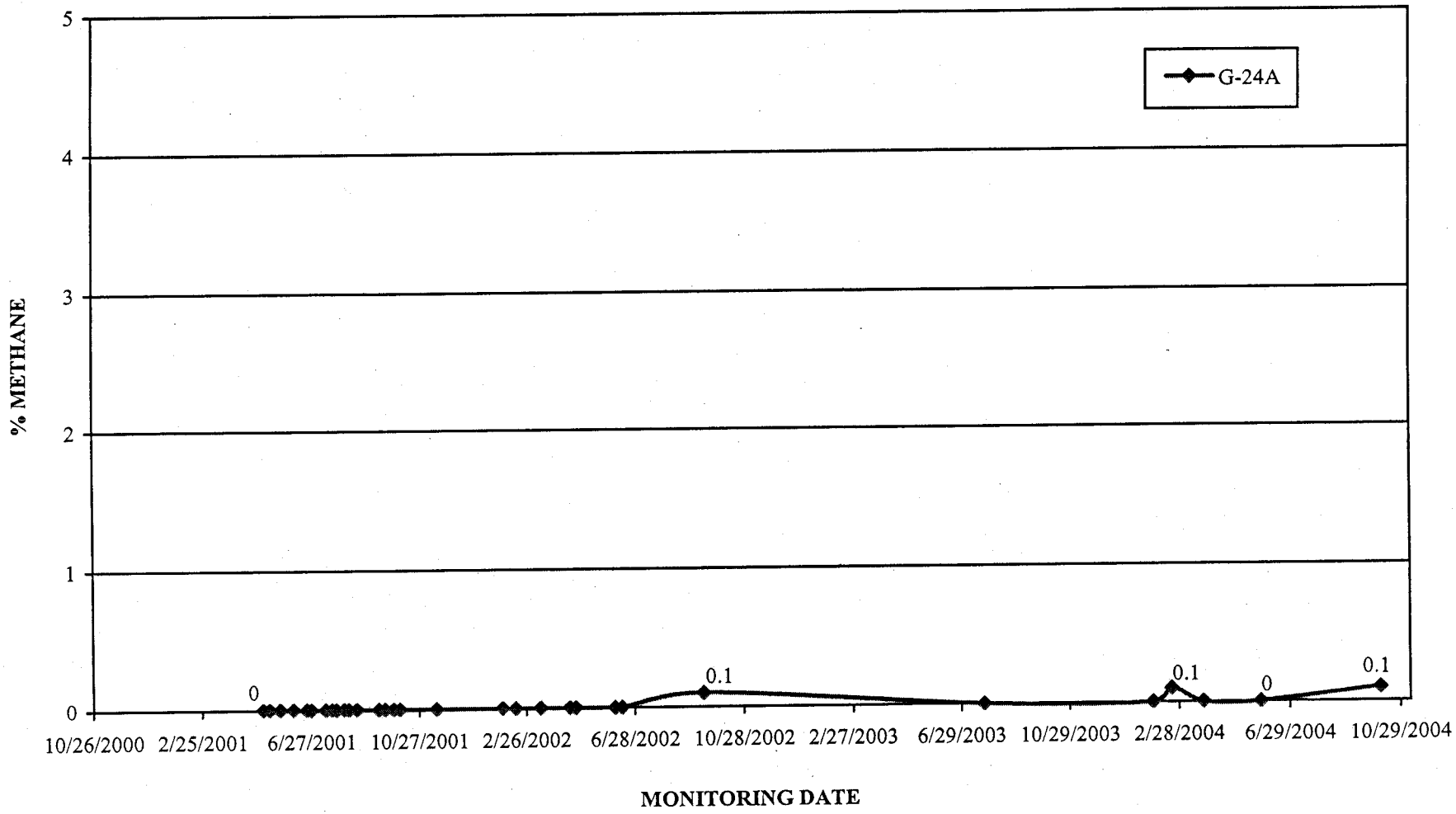

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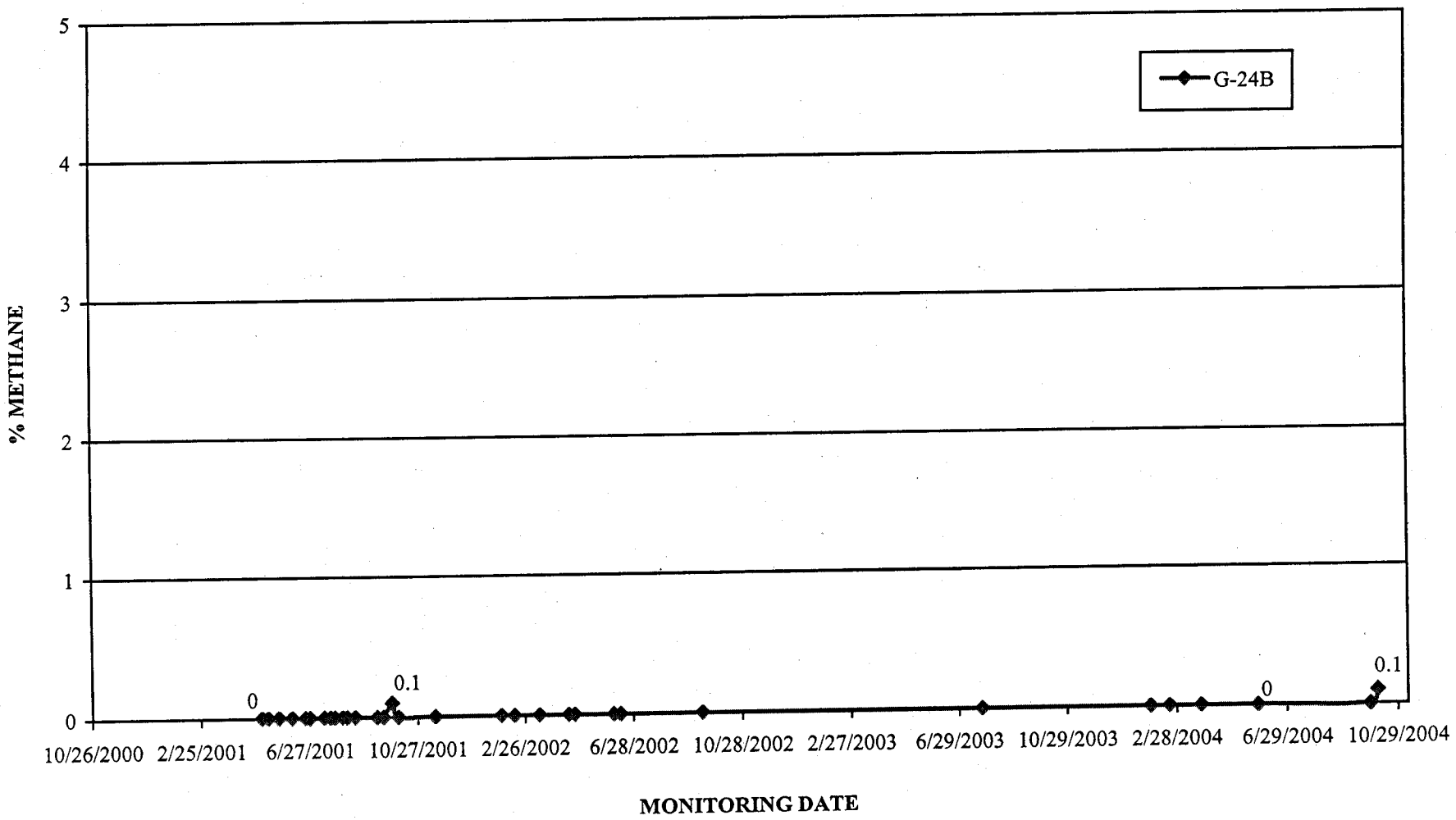

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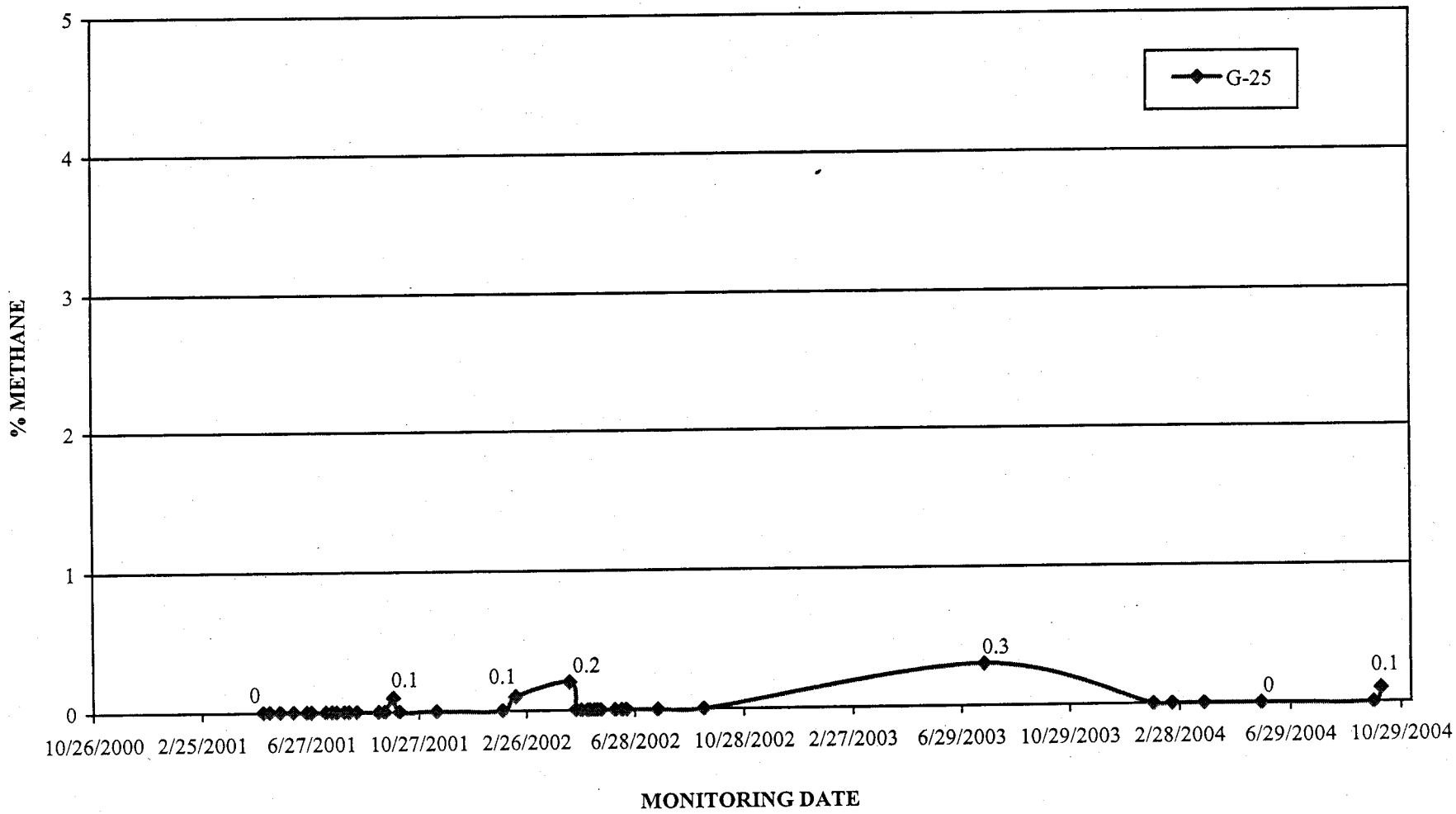

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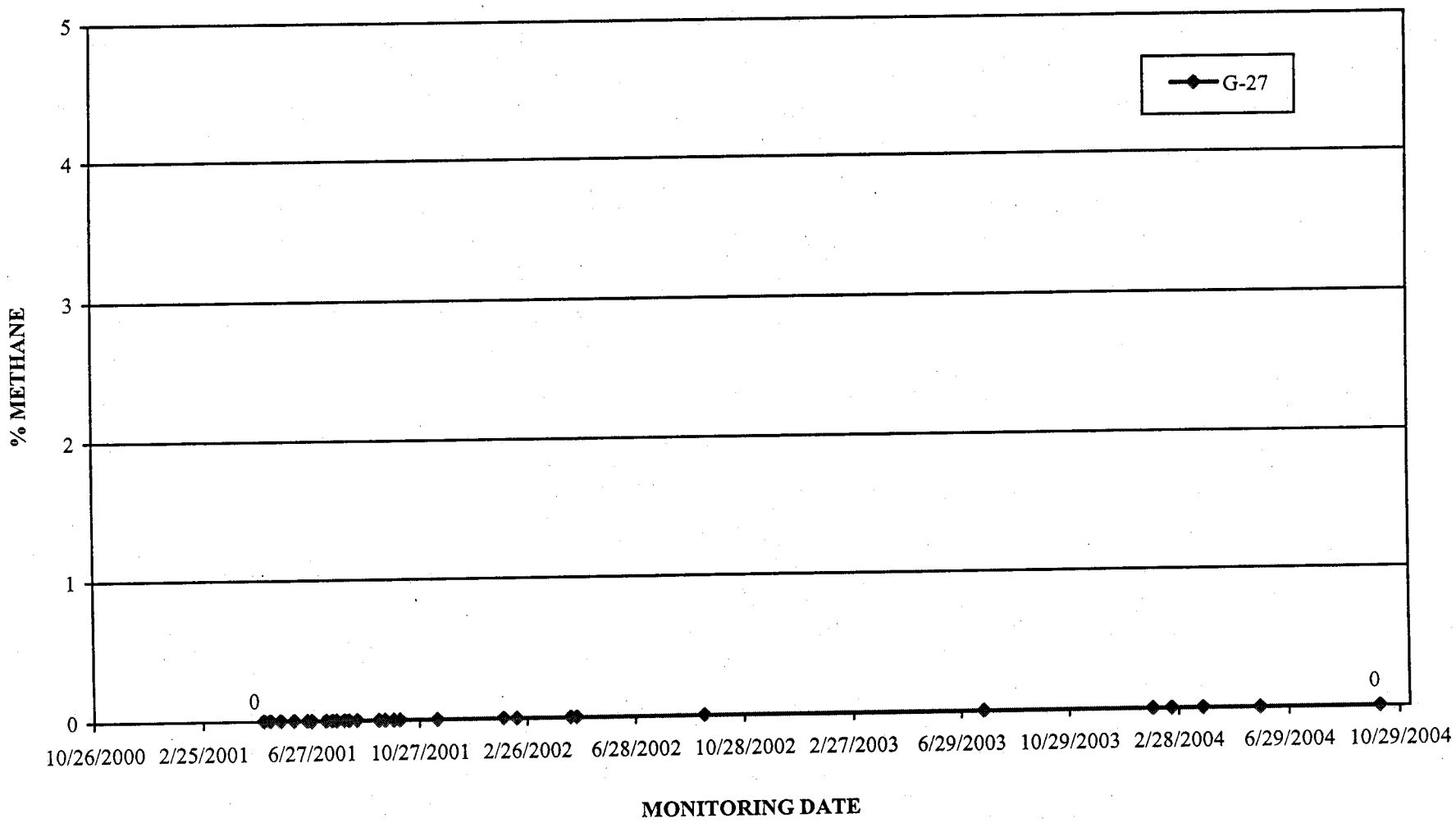

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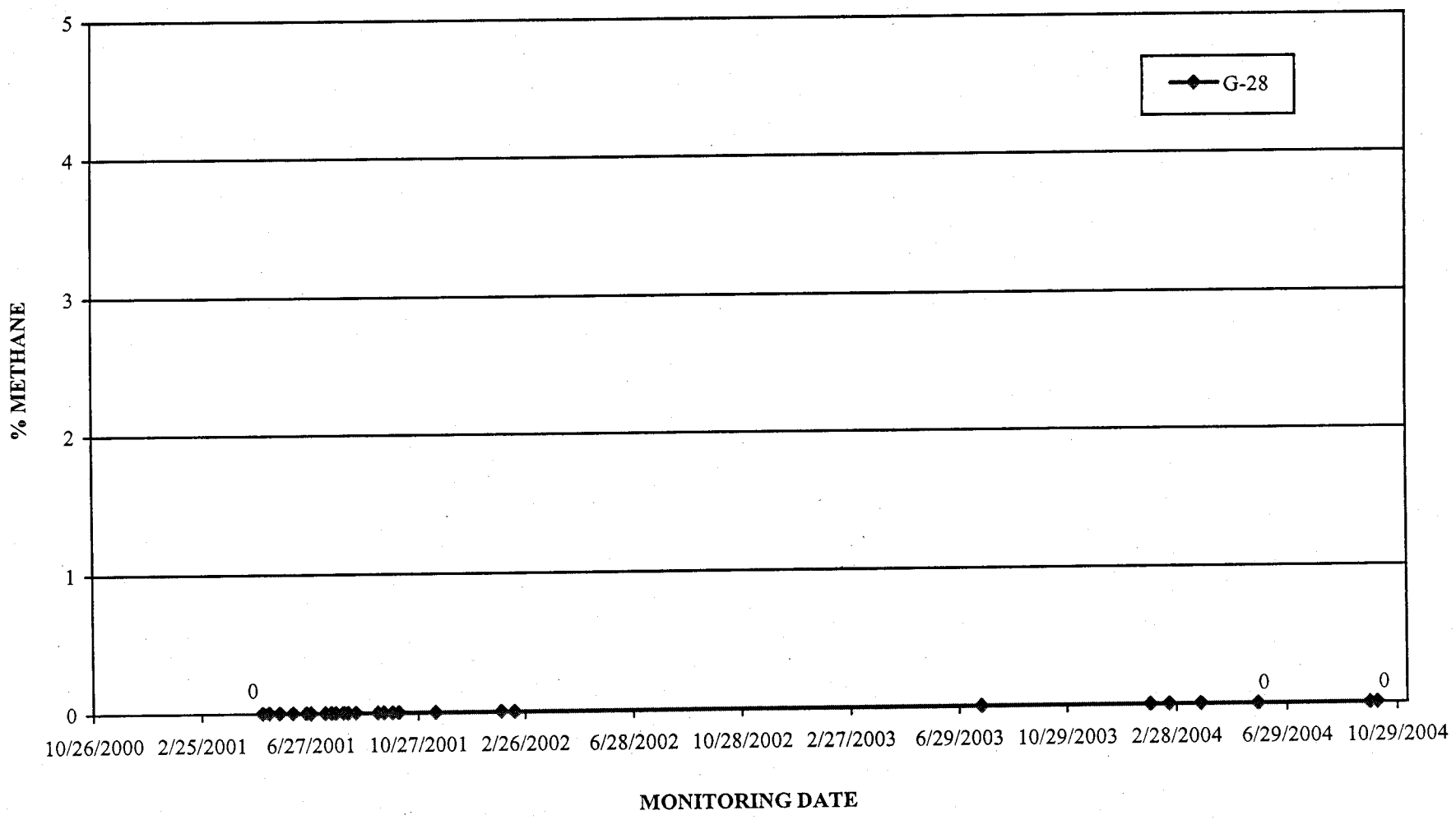

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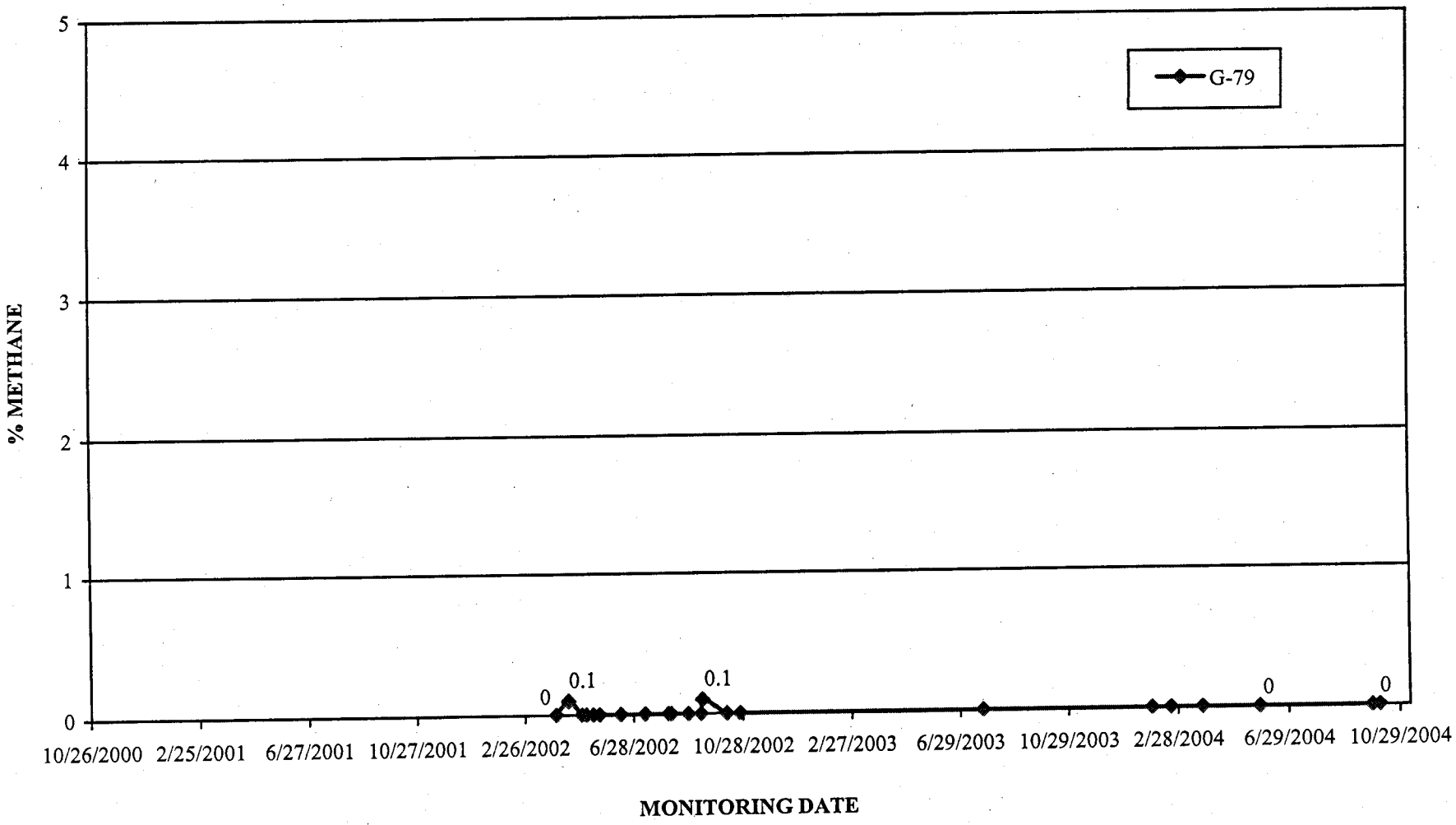

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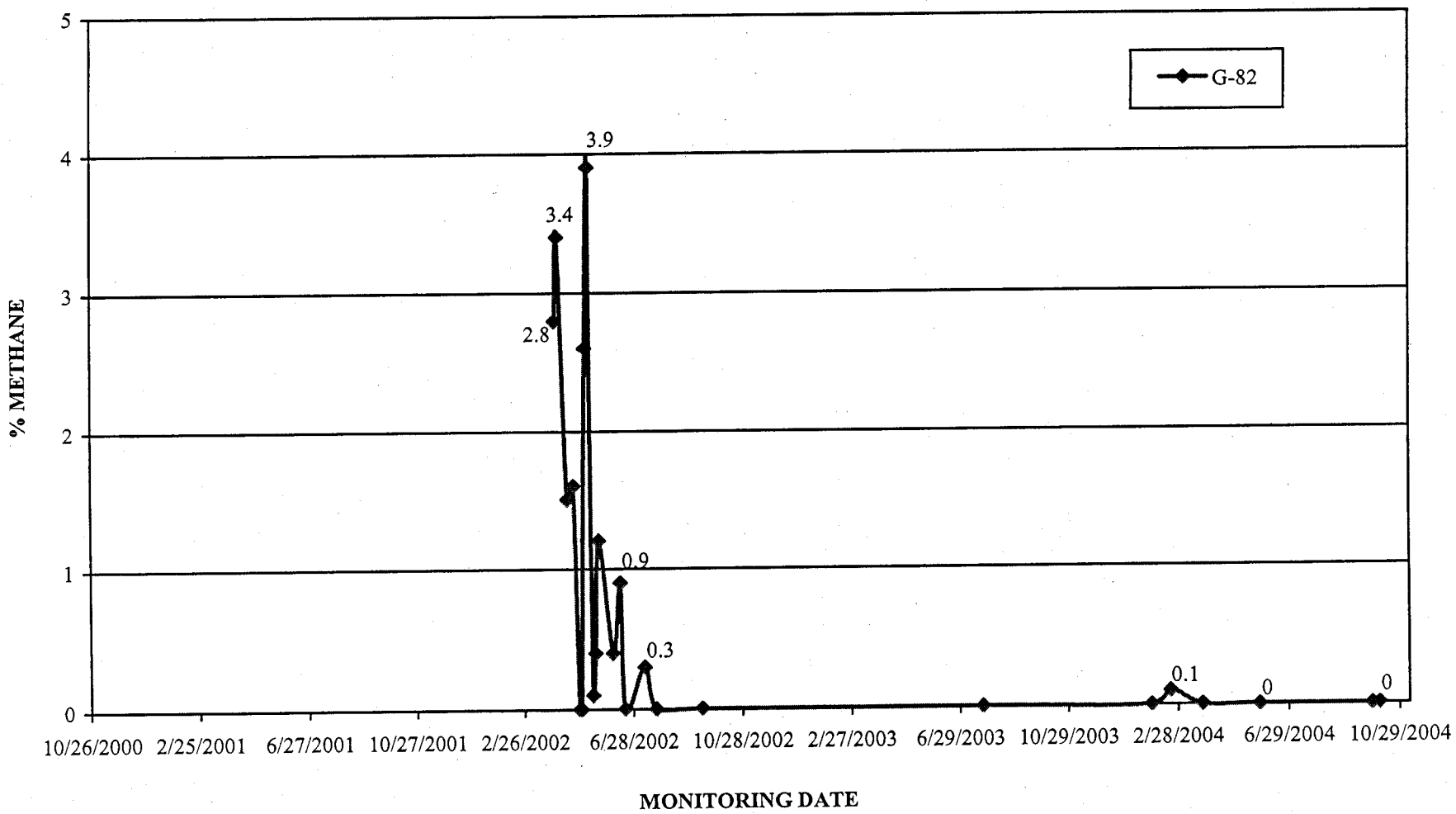

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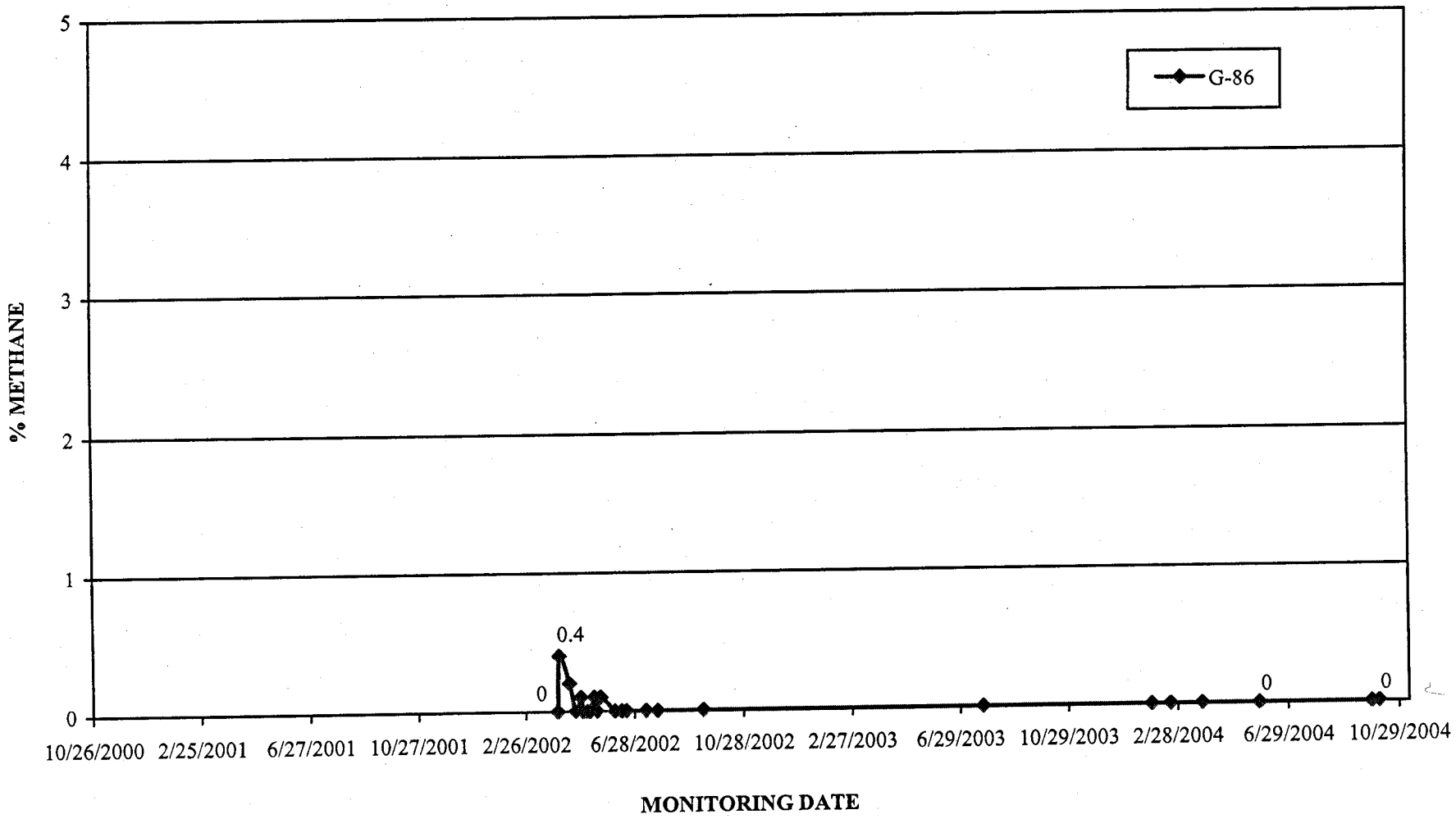

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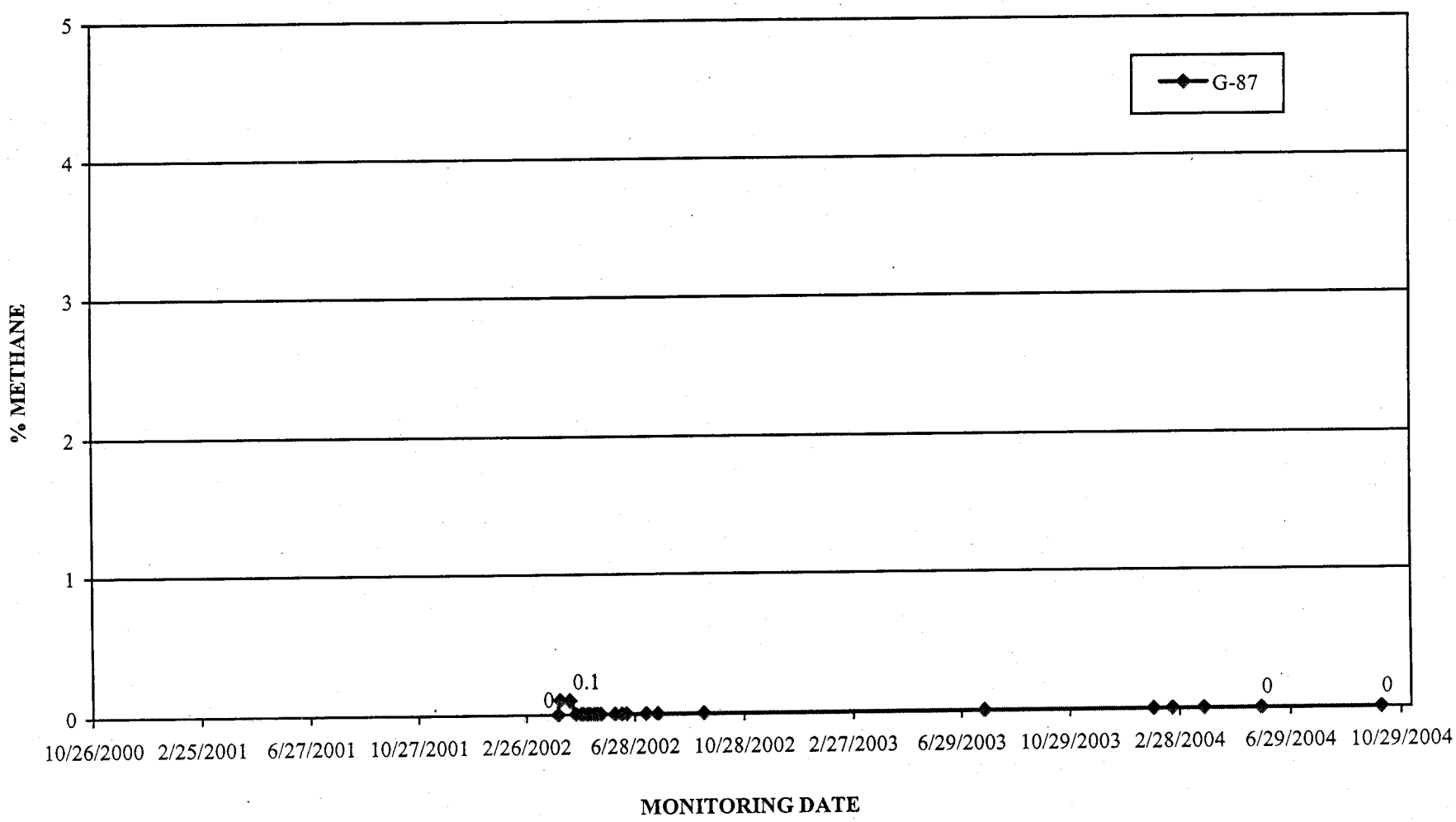

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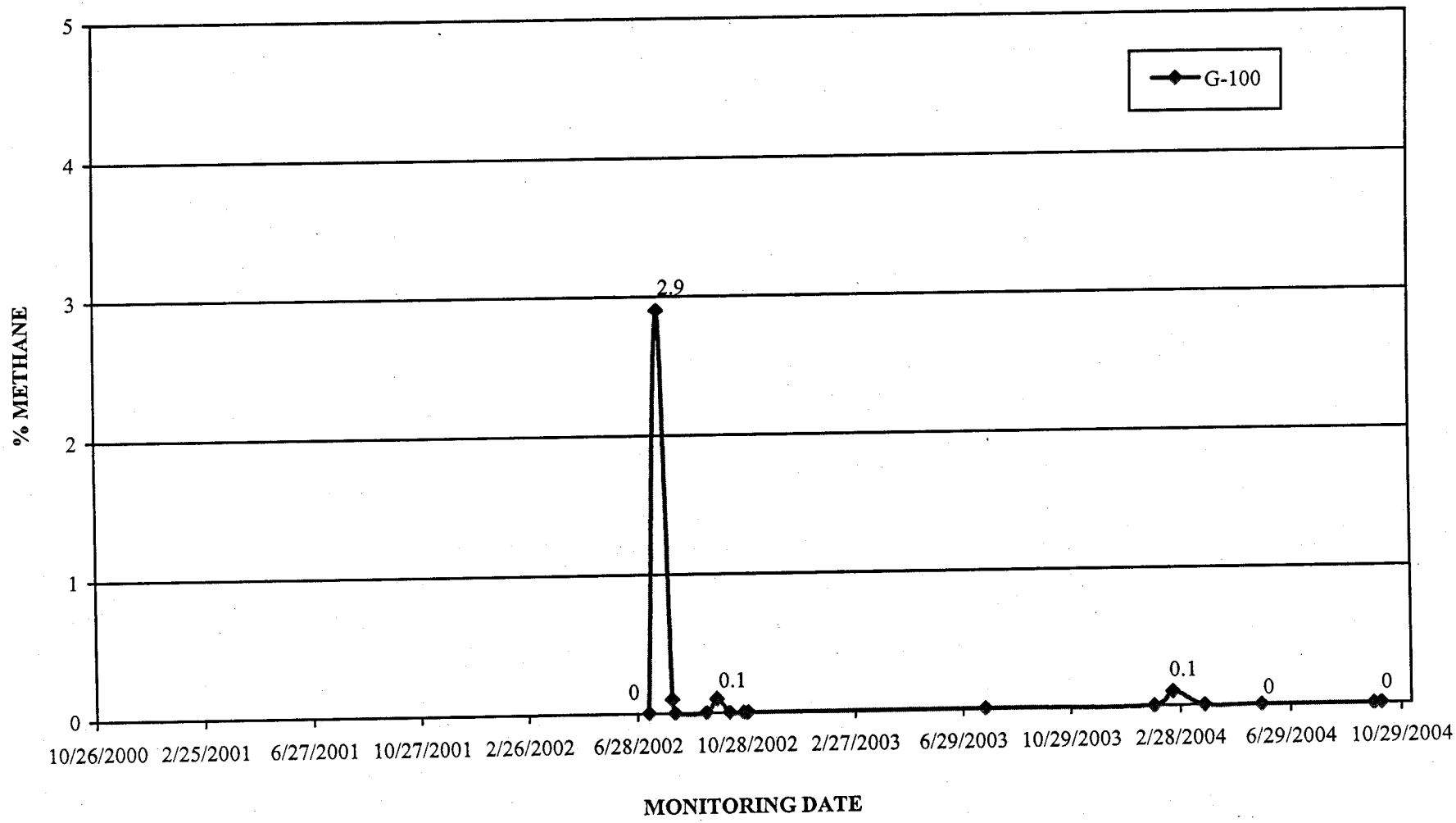

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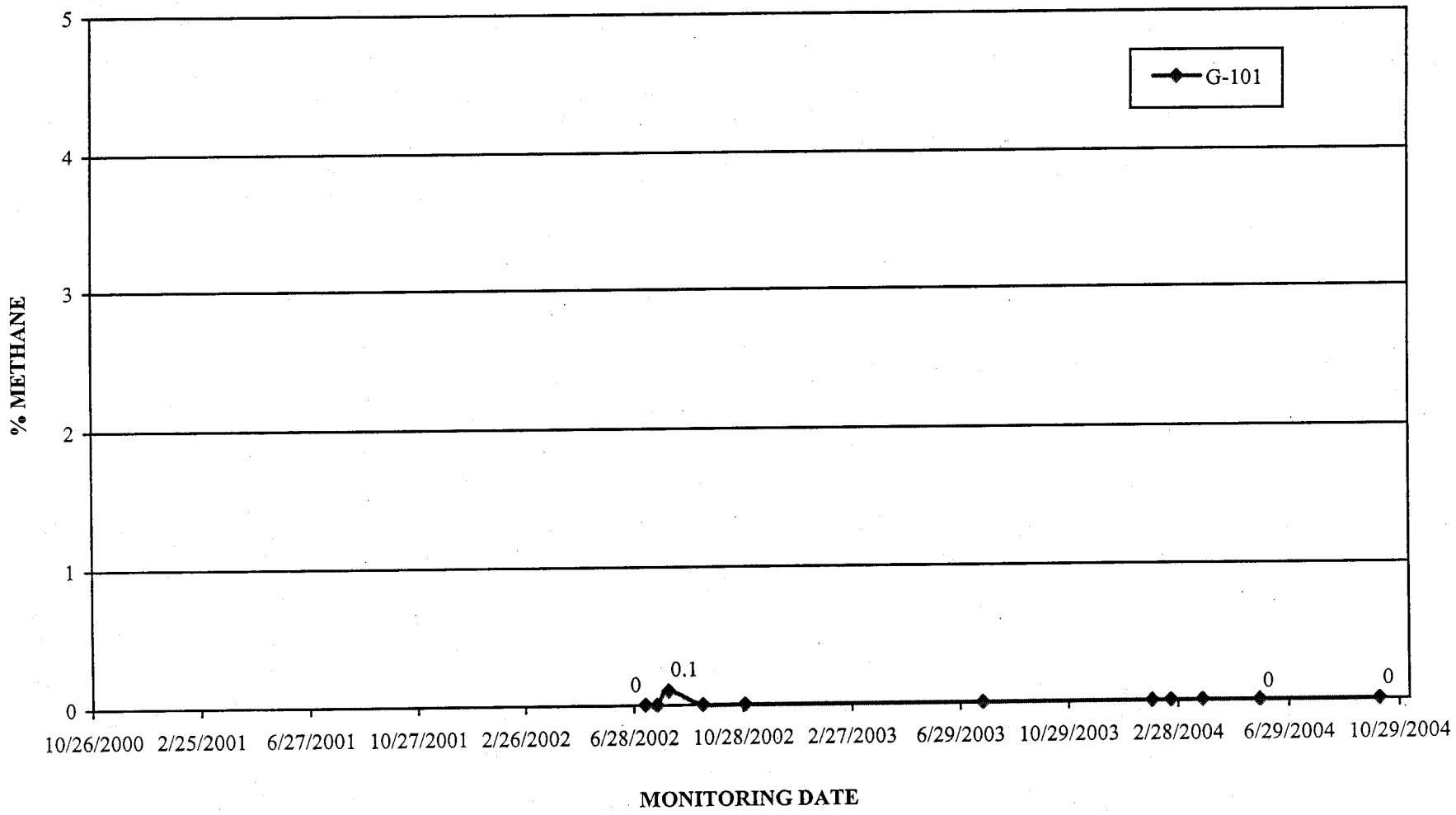

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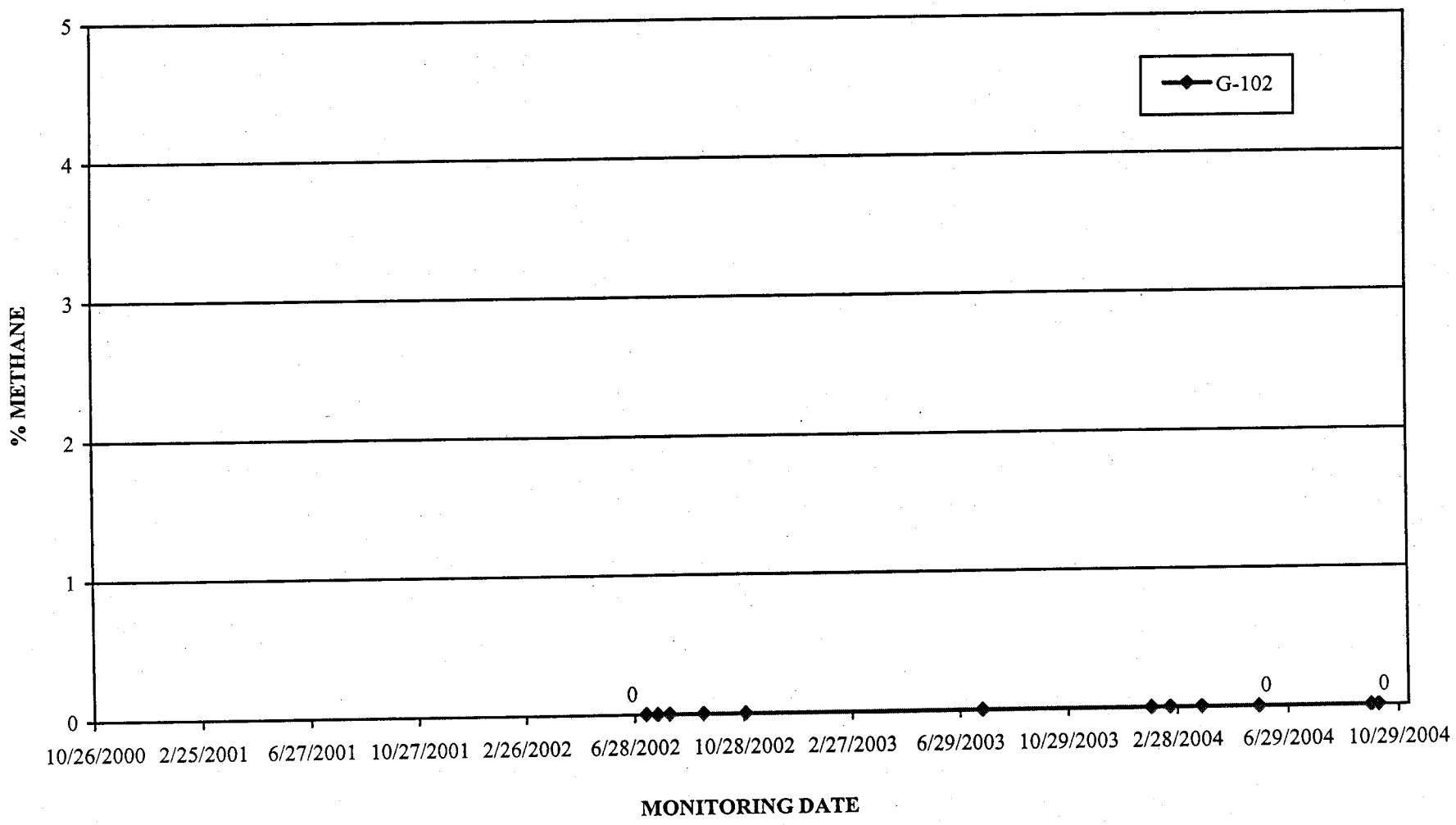

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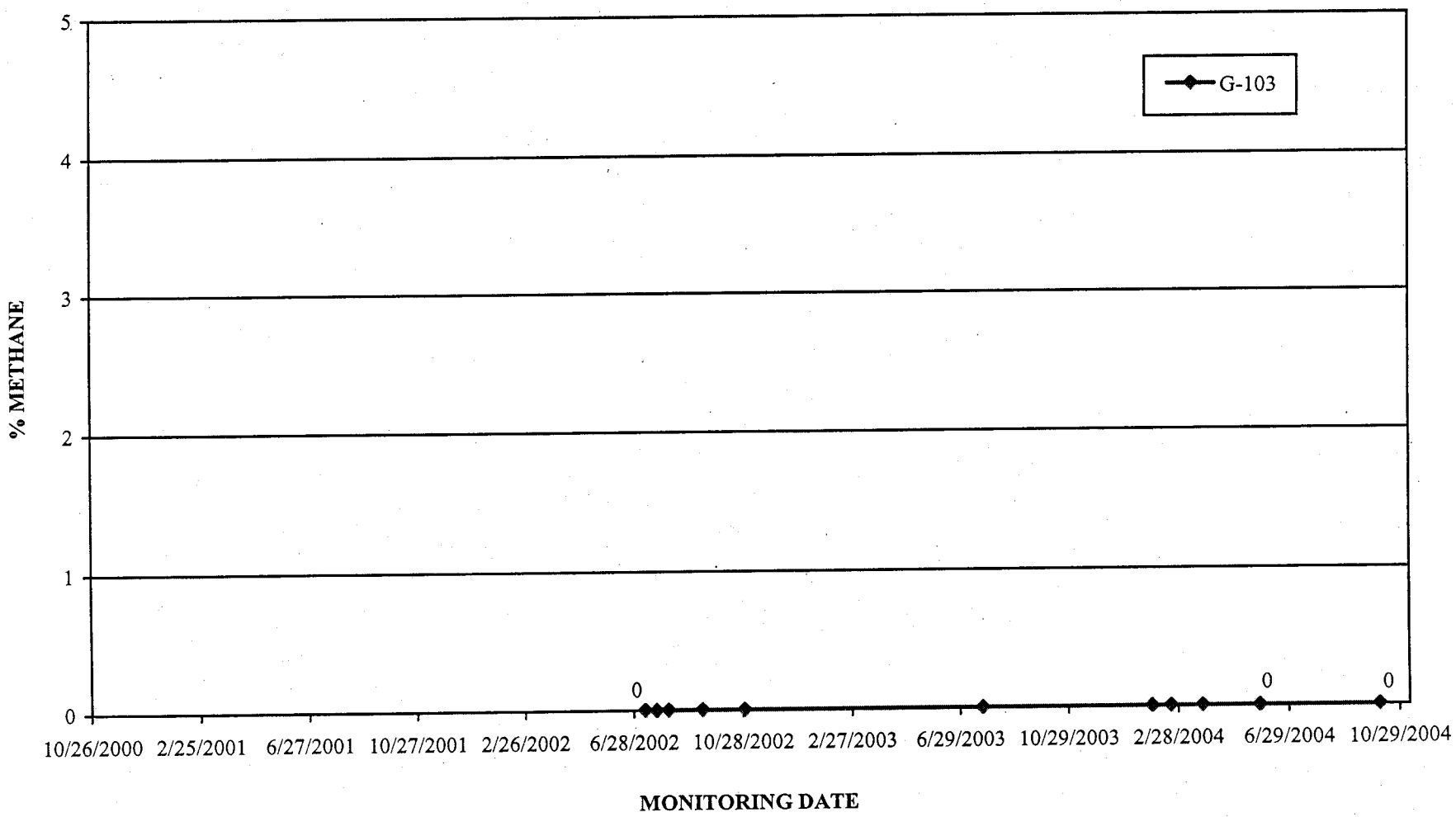

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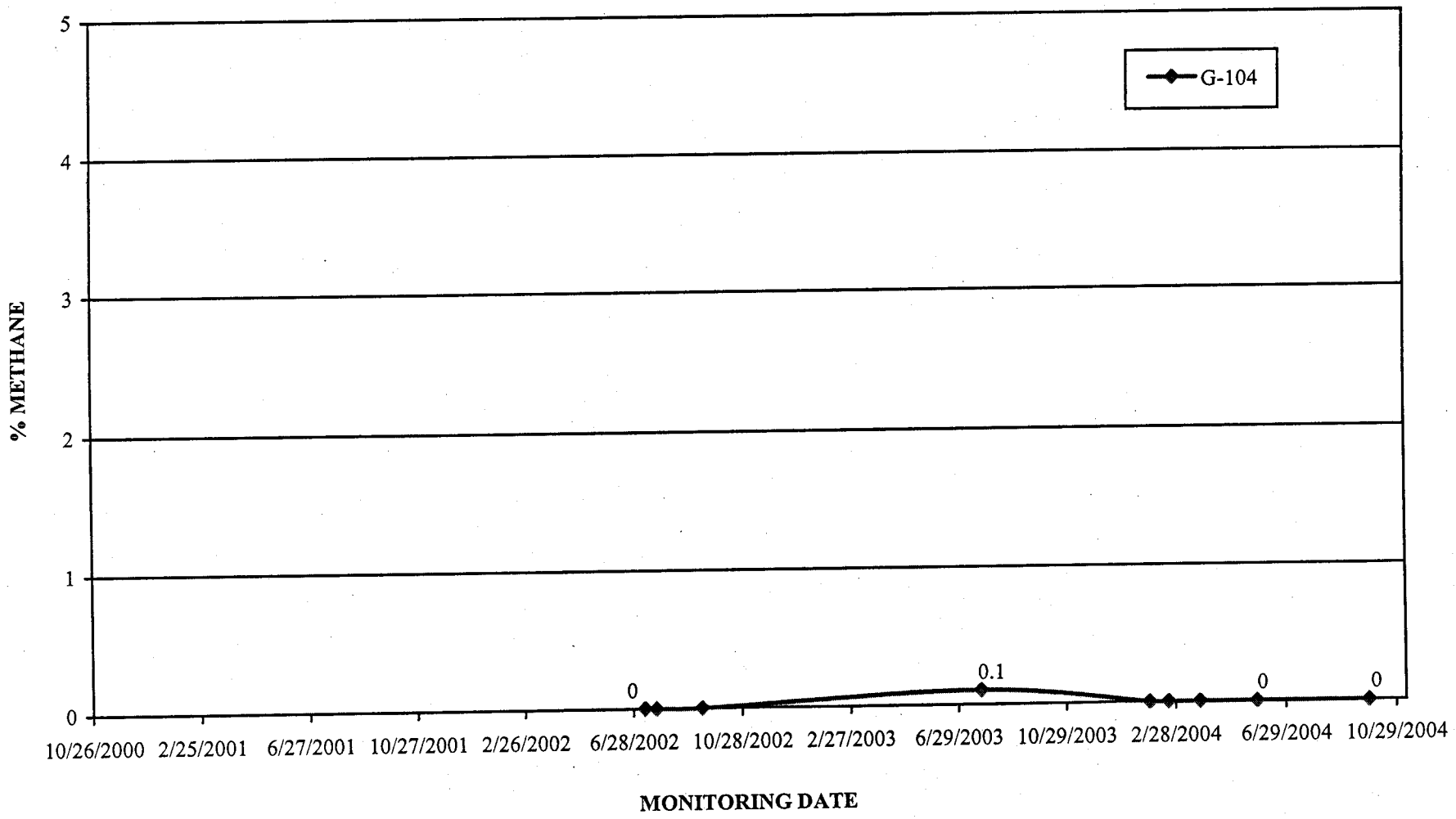

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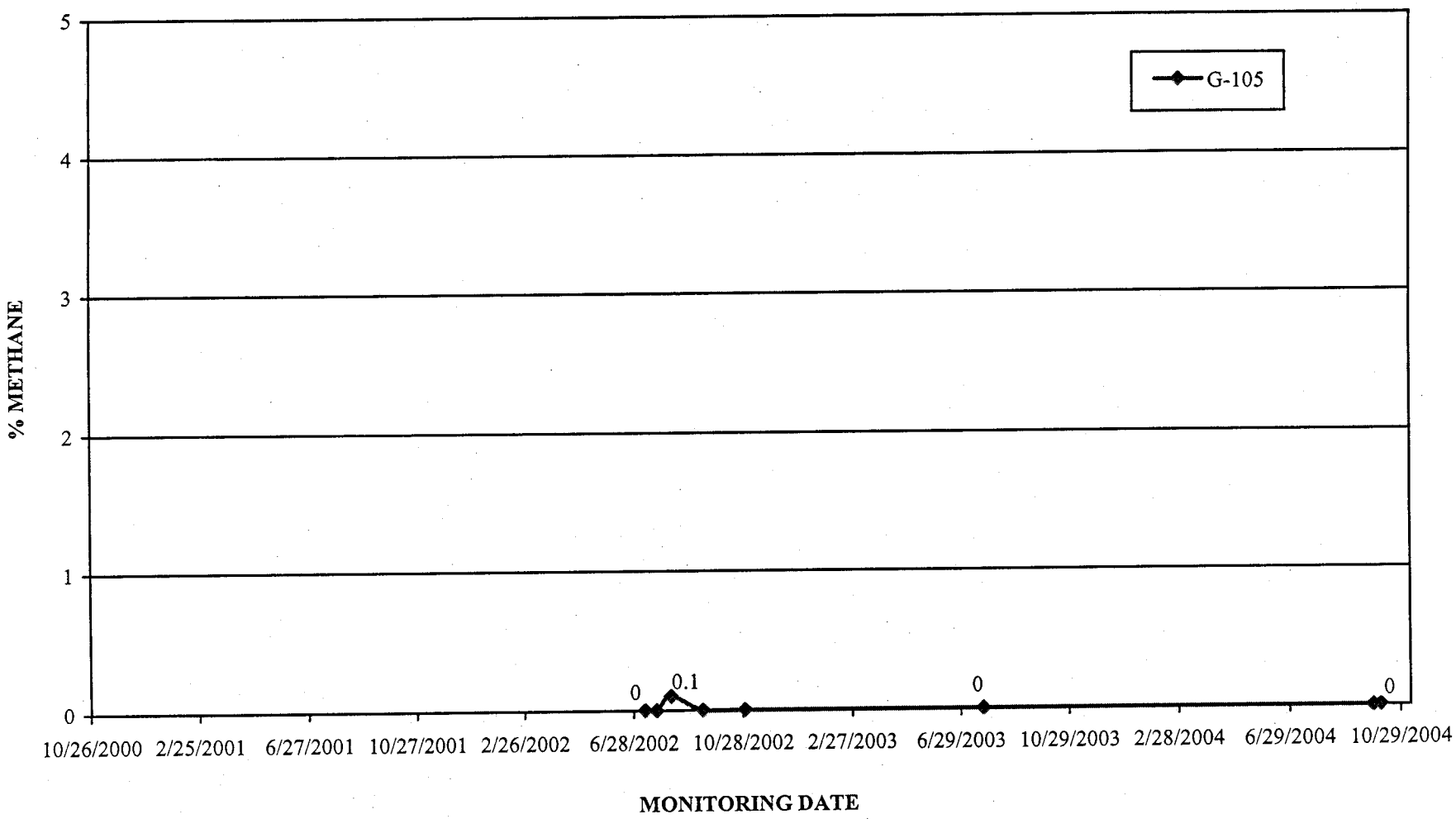

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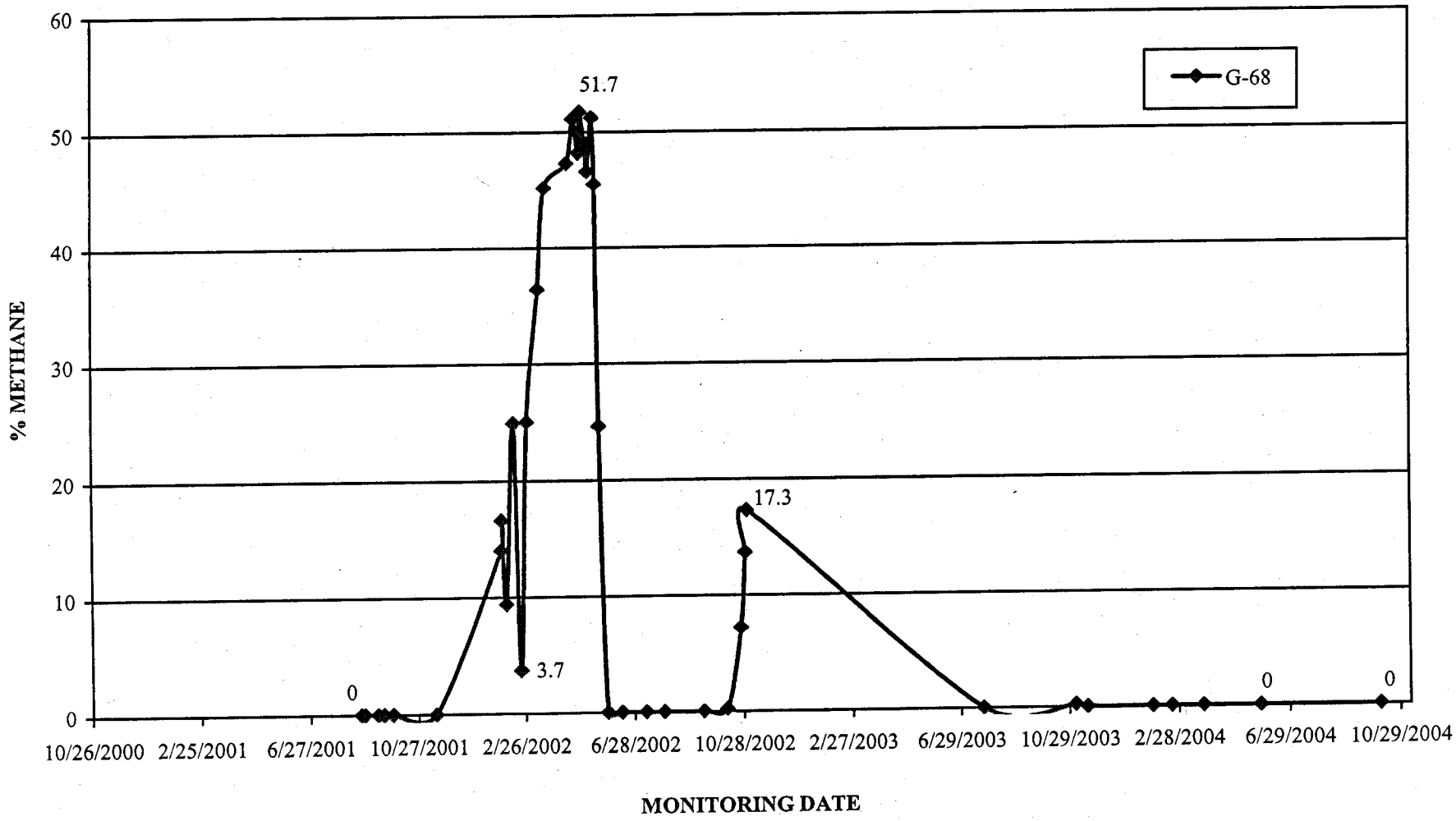
APPENDIX C

MONITORING DATA FOR TEMPORARY LFG MONITORING PROBES DEMONSTRATING DECREASING METHANE TREND

METHANE MIGRATION TRENDS IN TEMPORARY LFG MONITORING PROBES
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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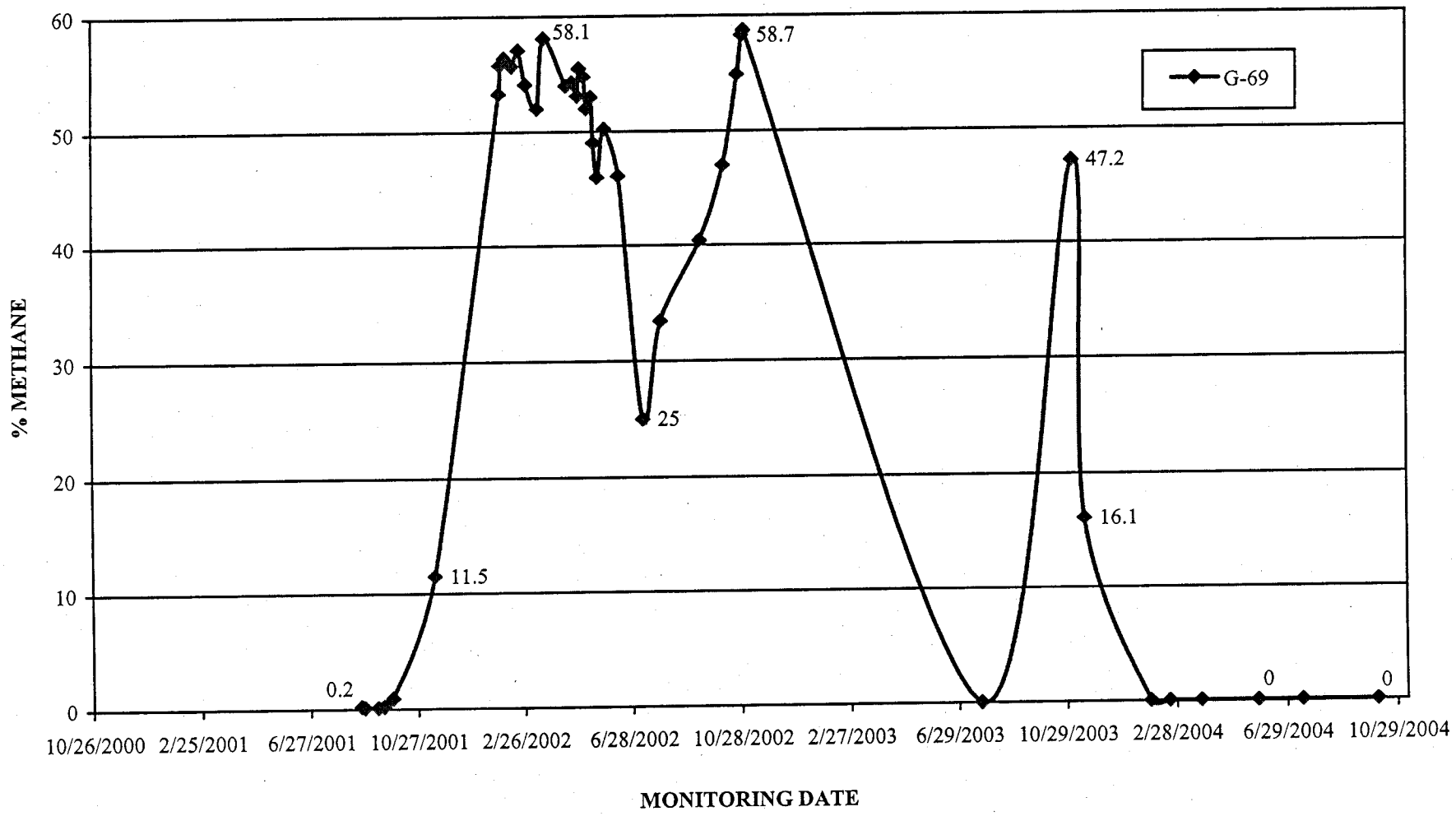

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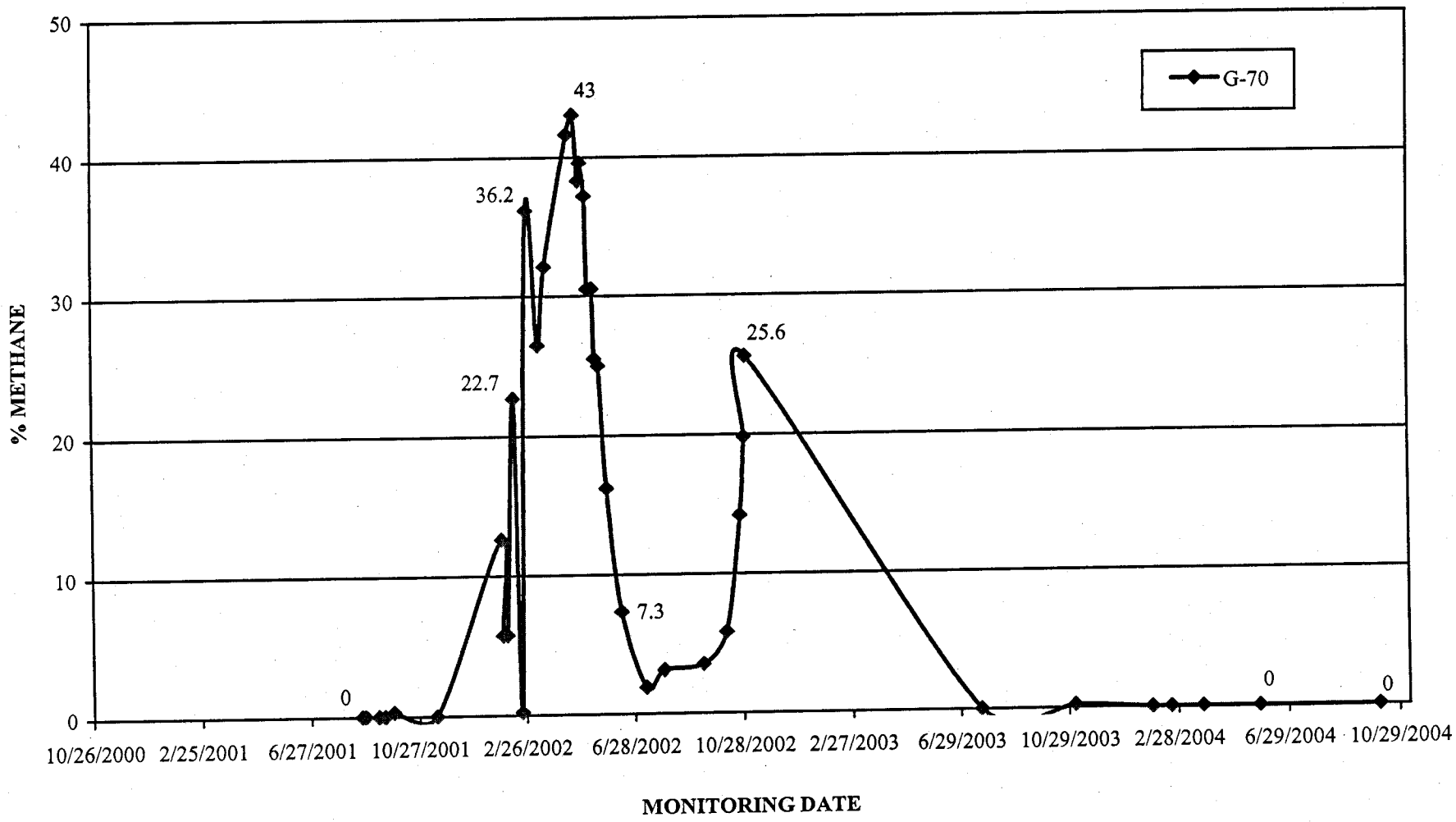

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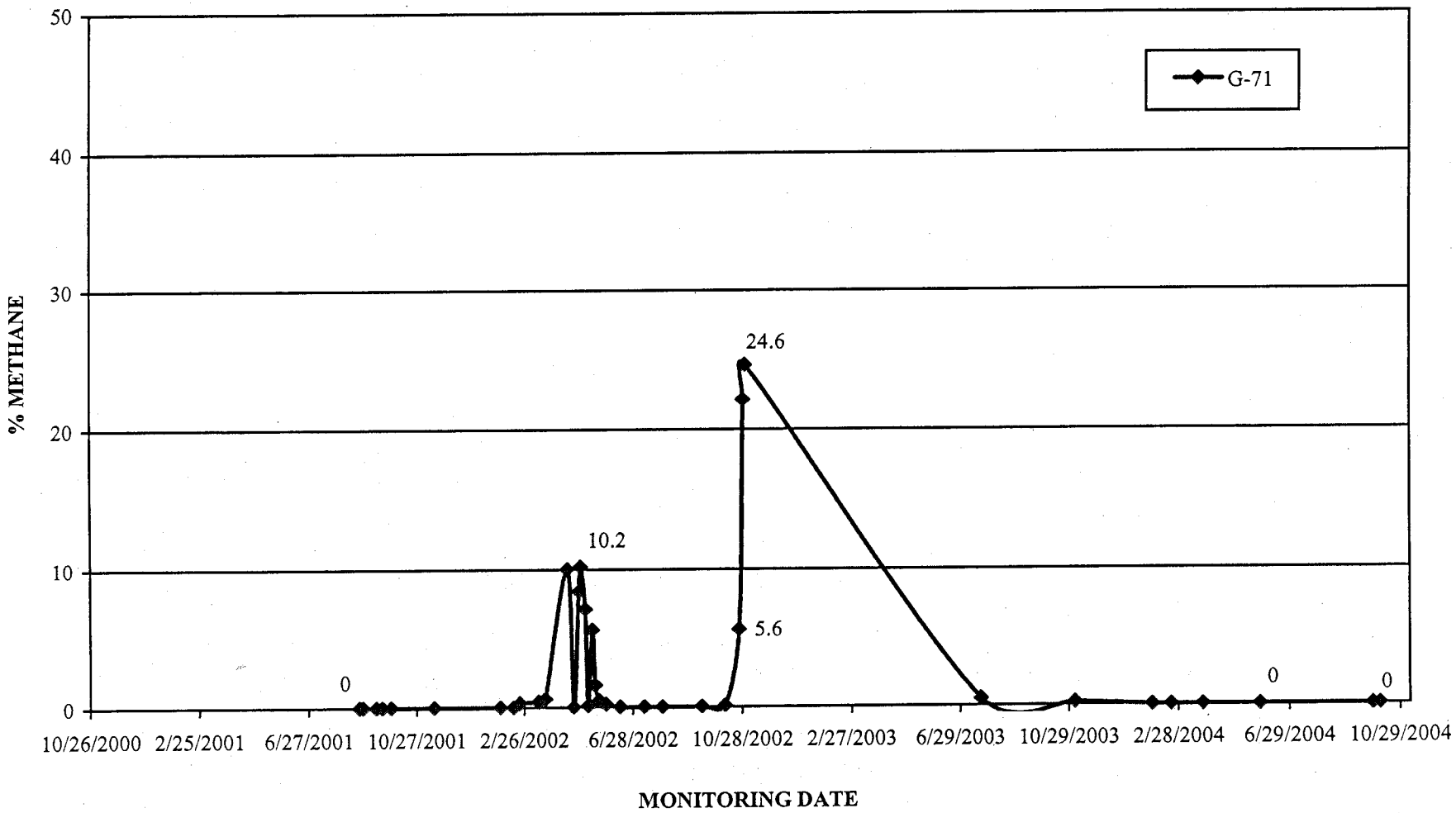

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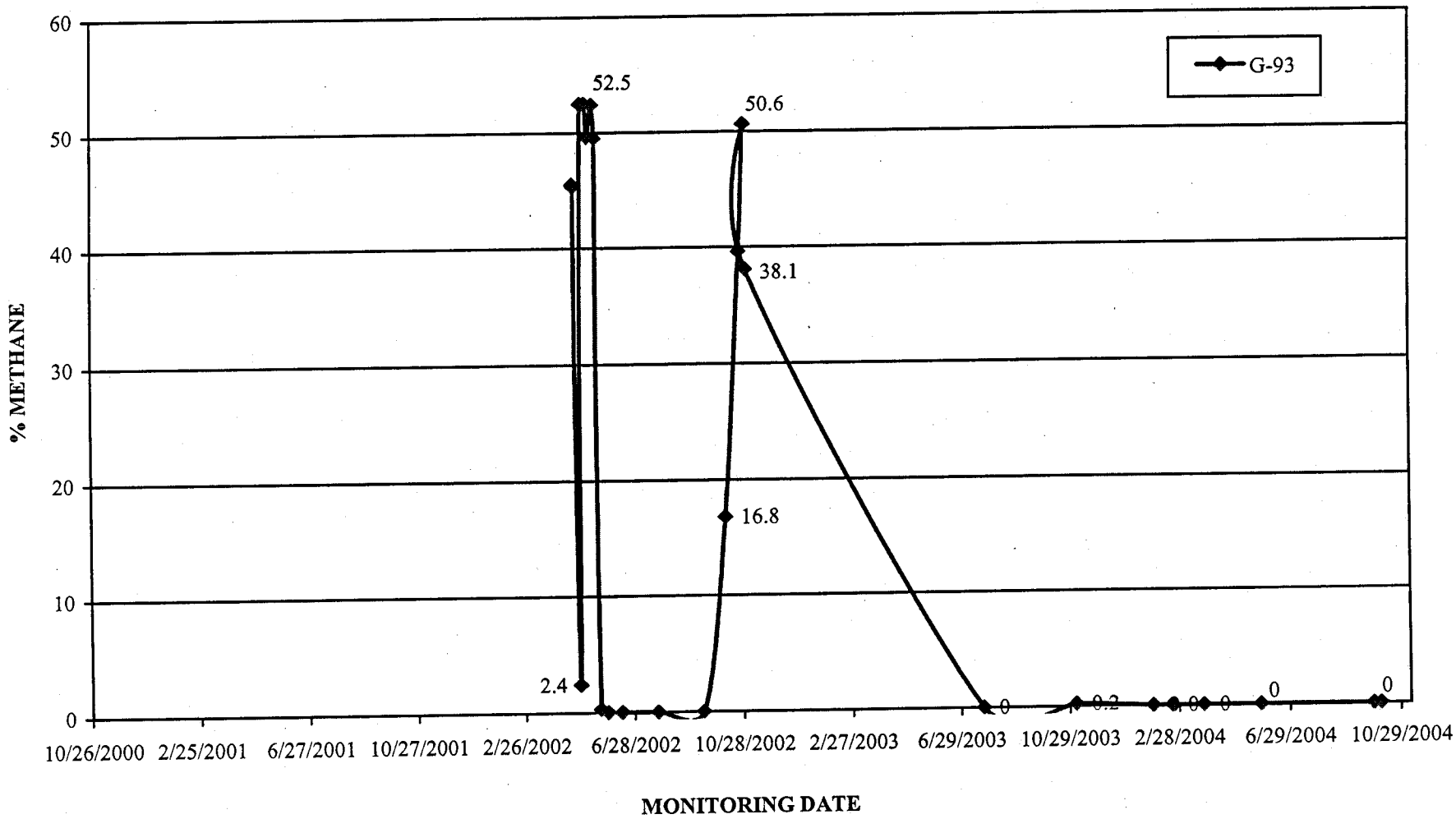

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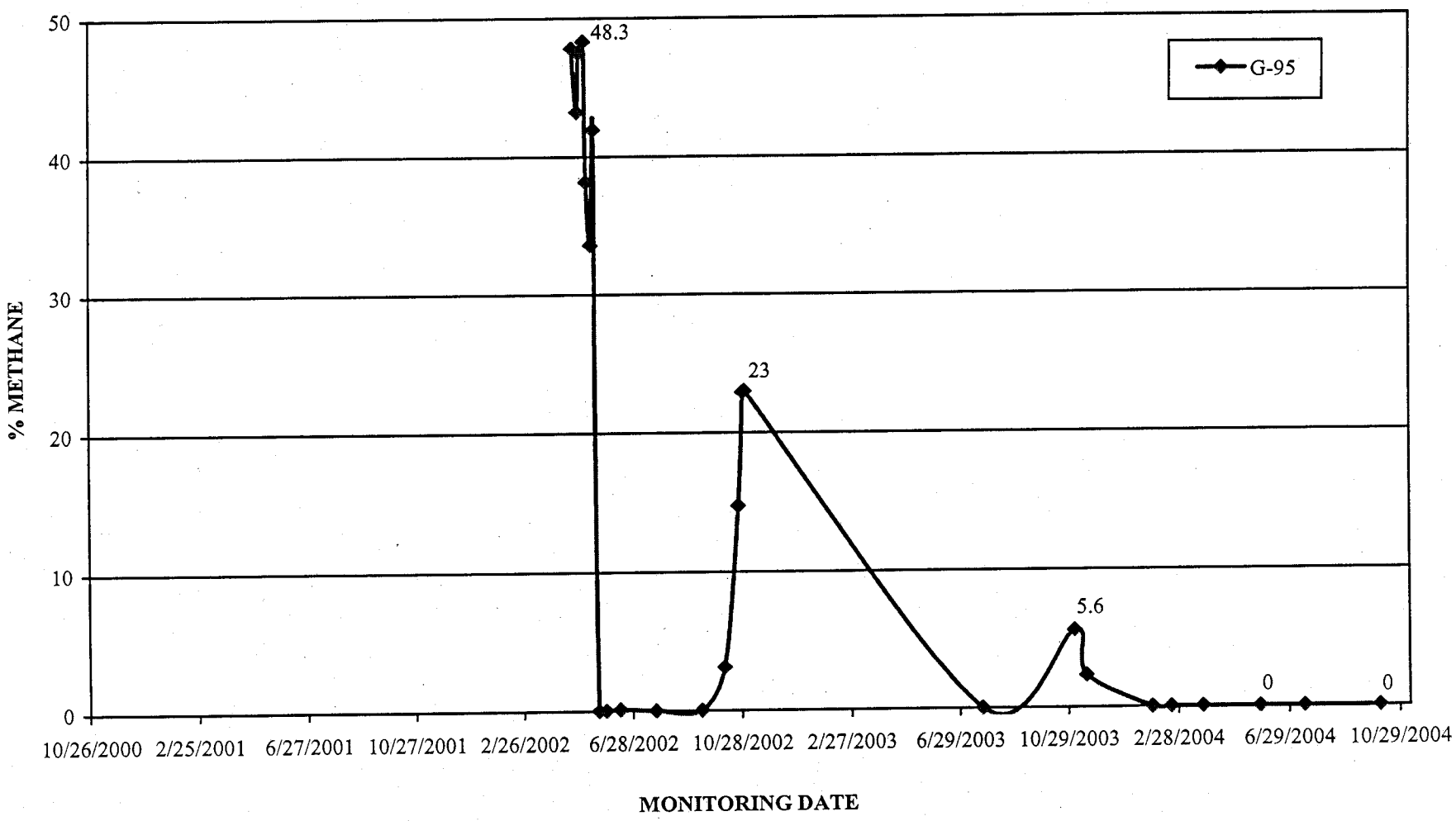

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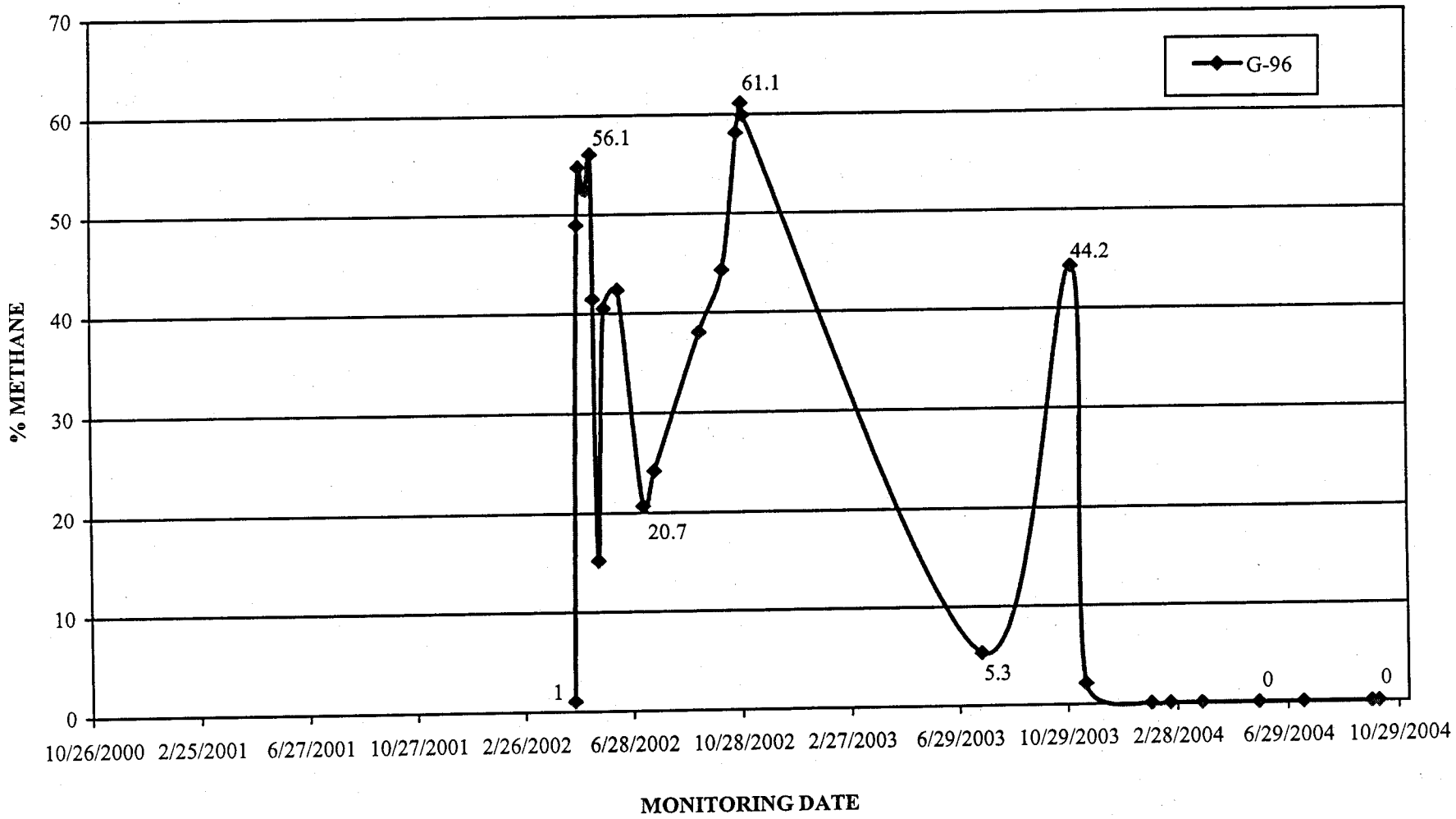

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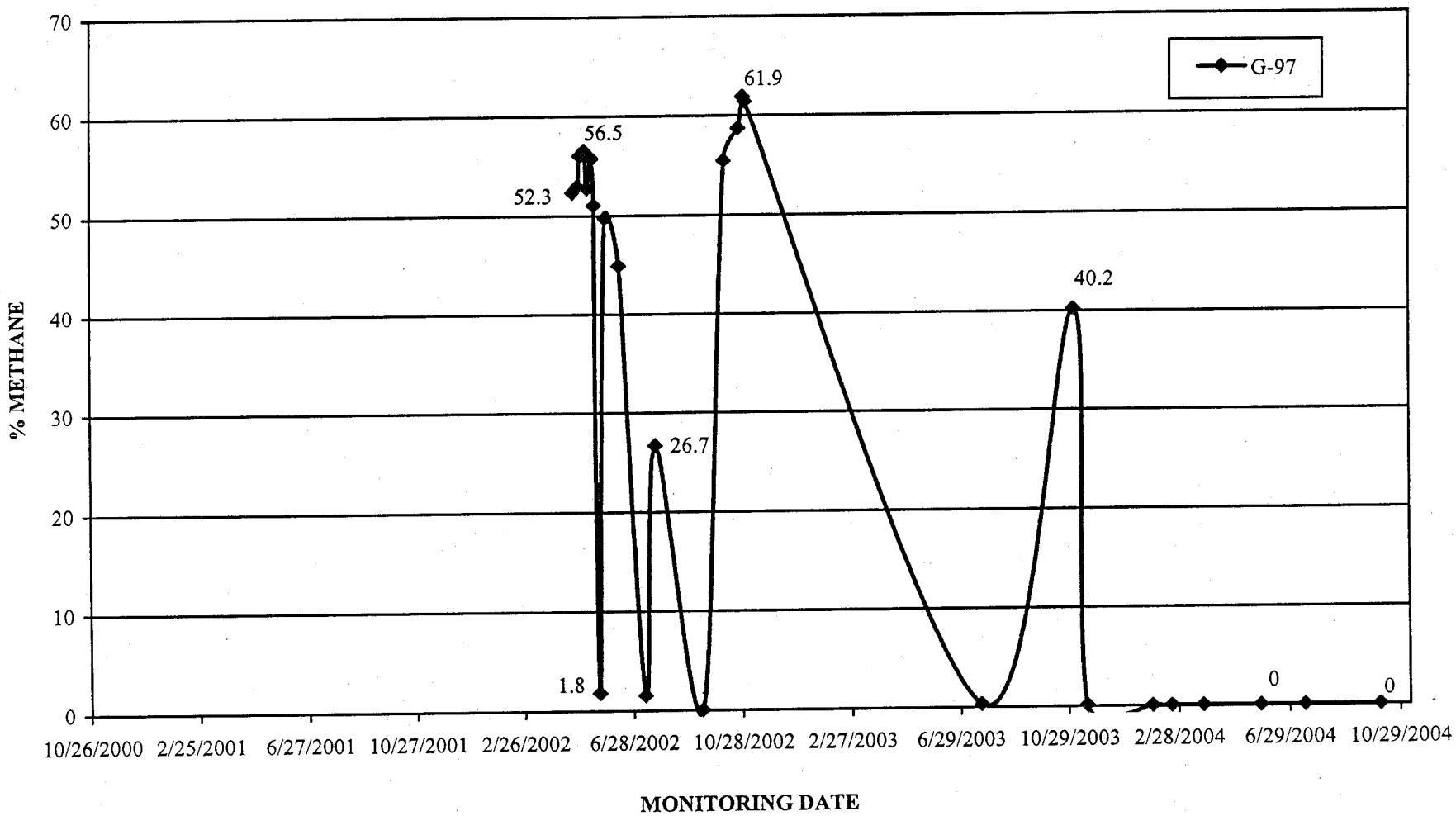

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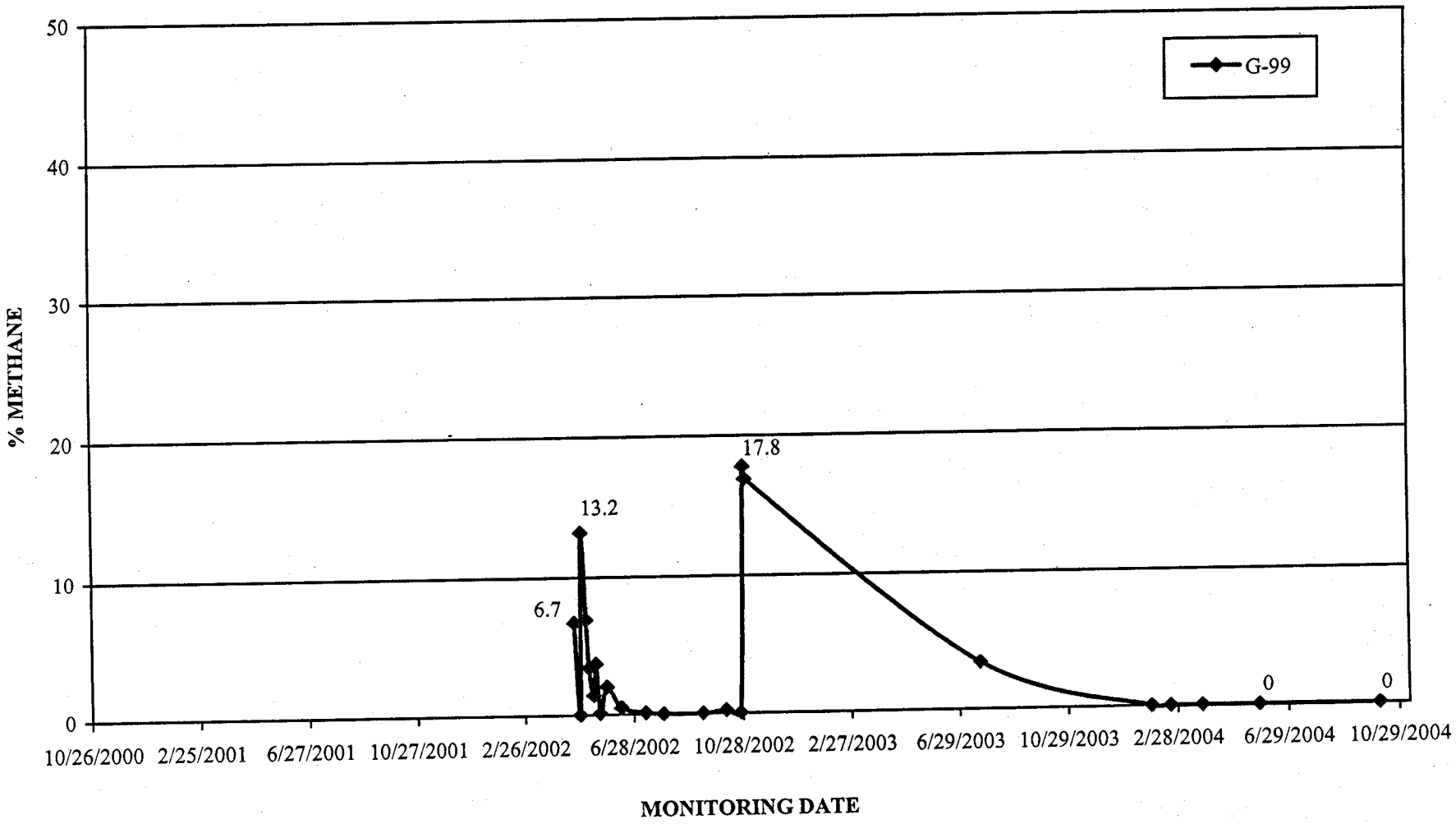

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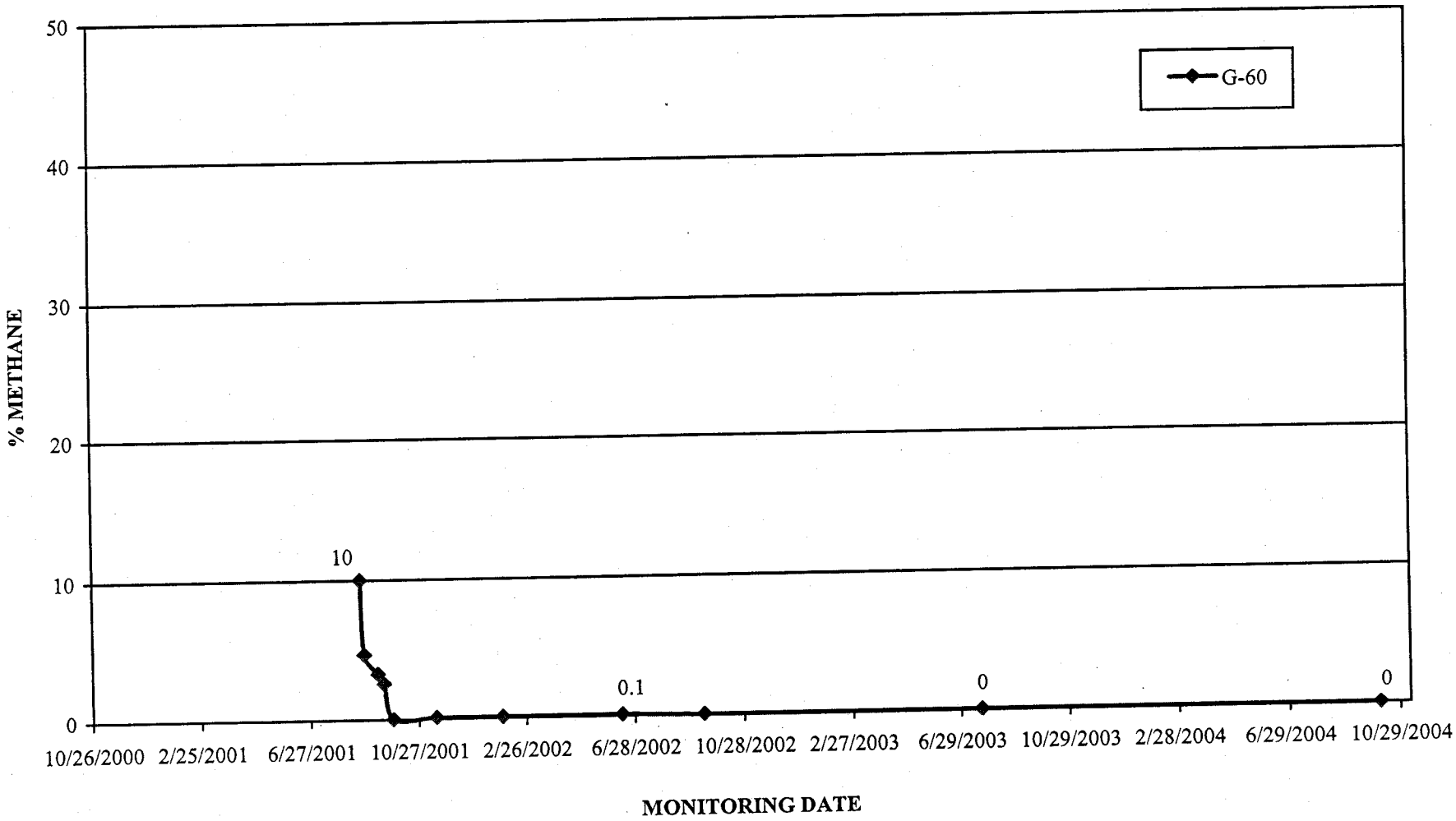

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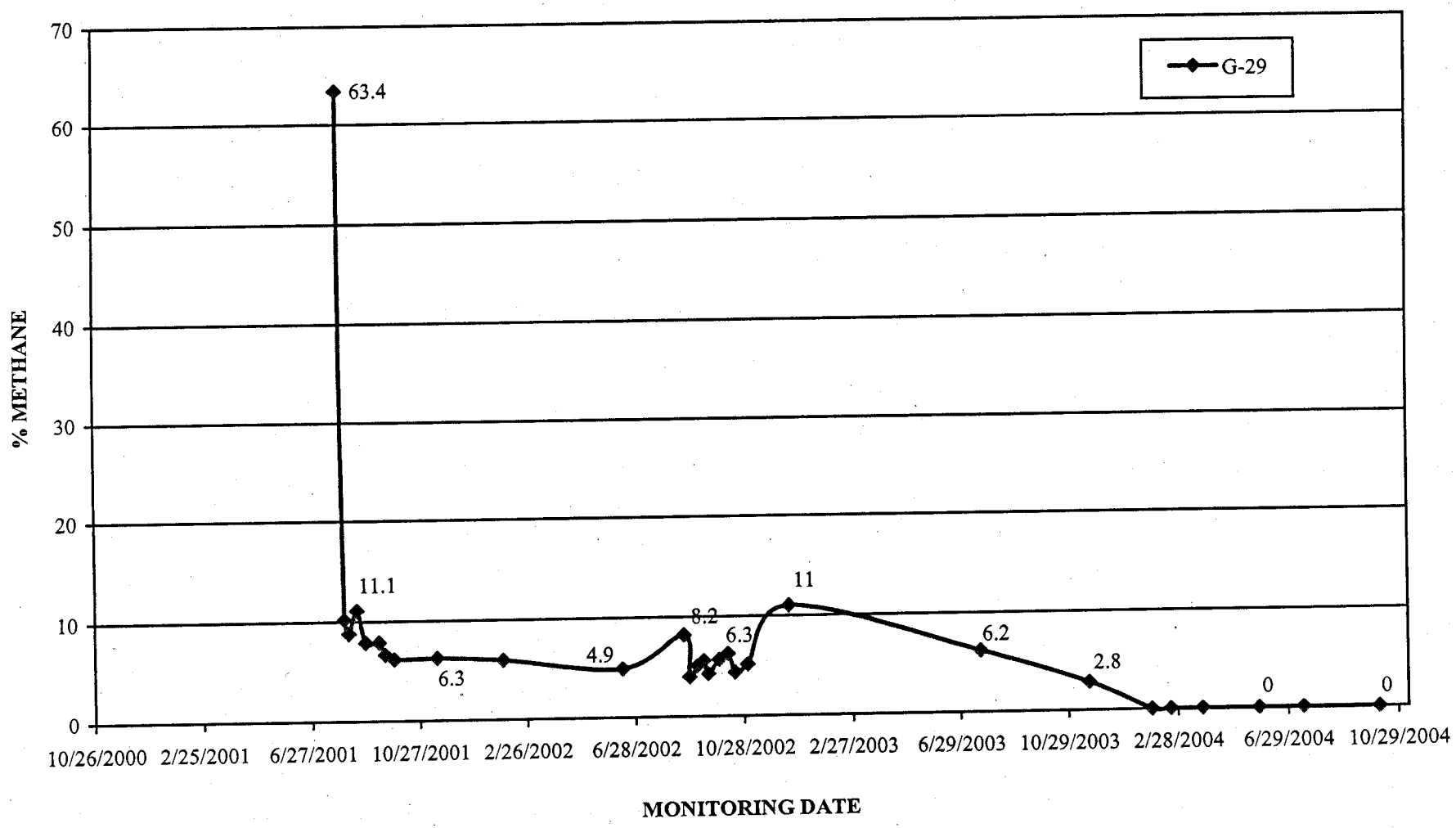

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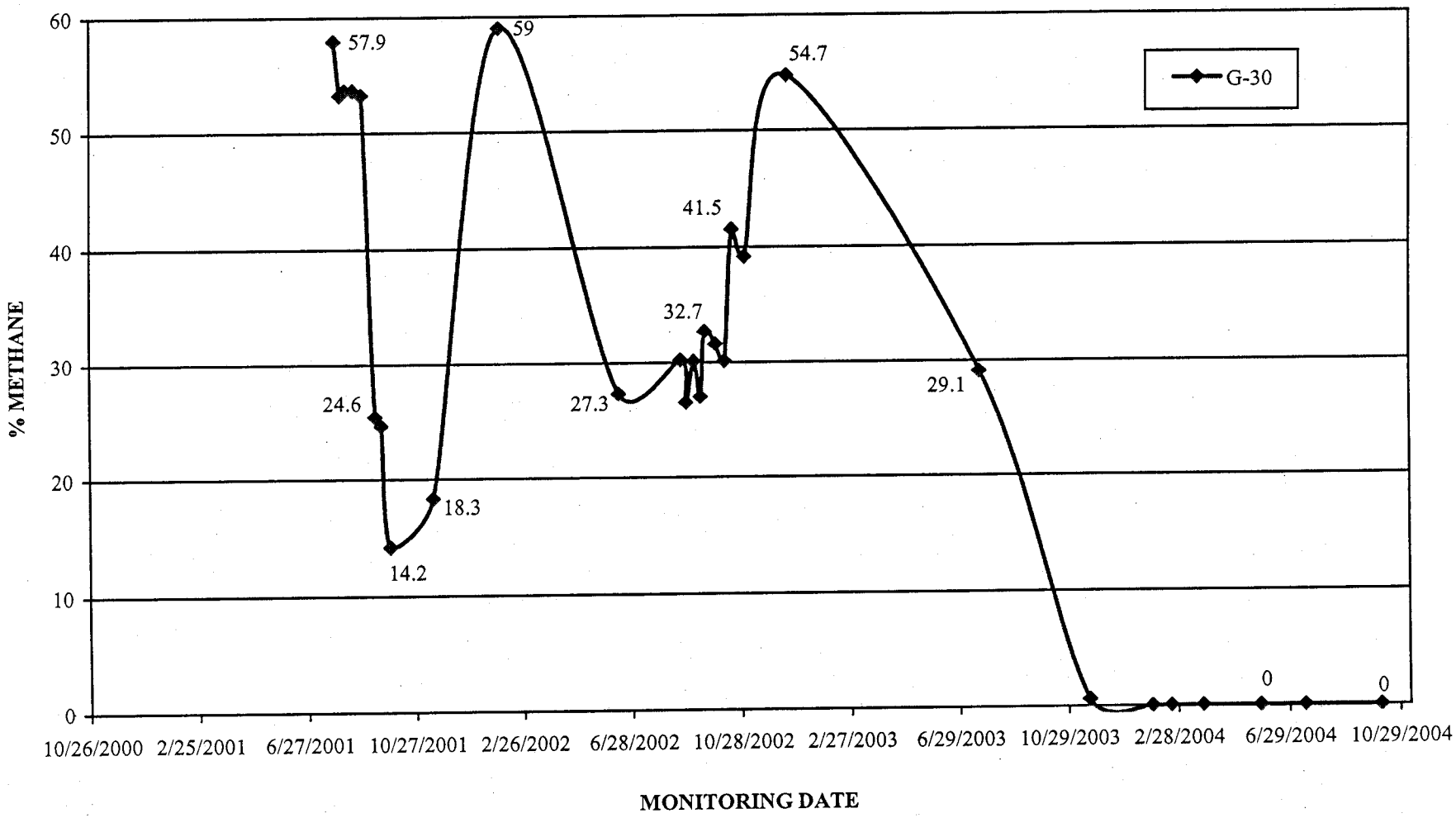

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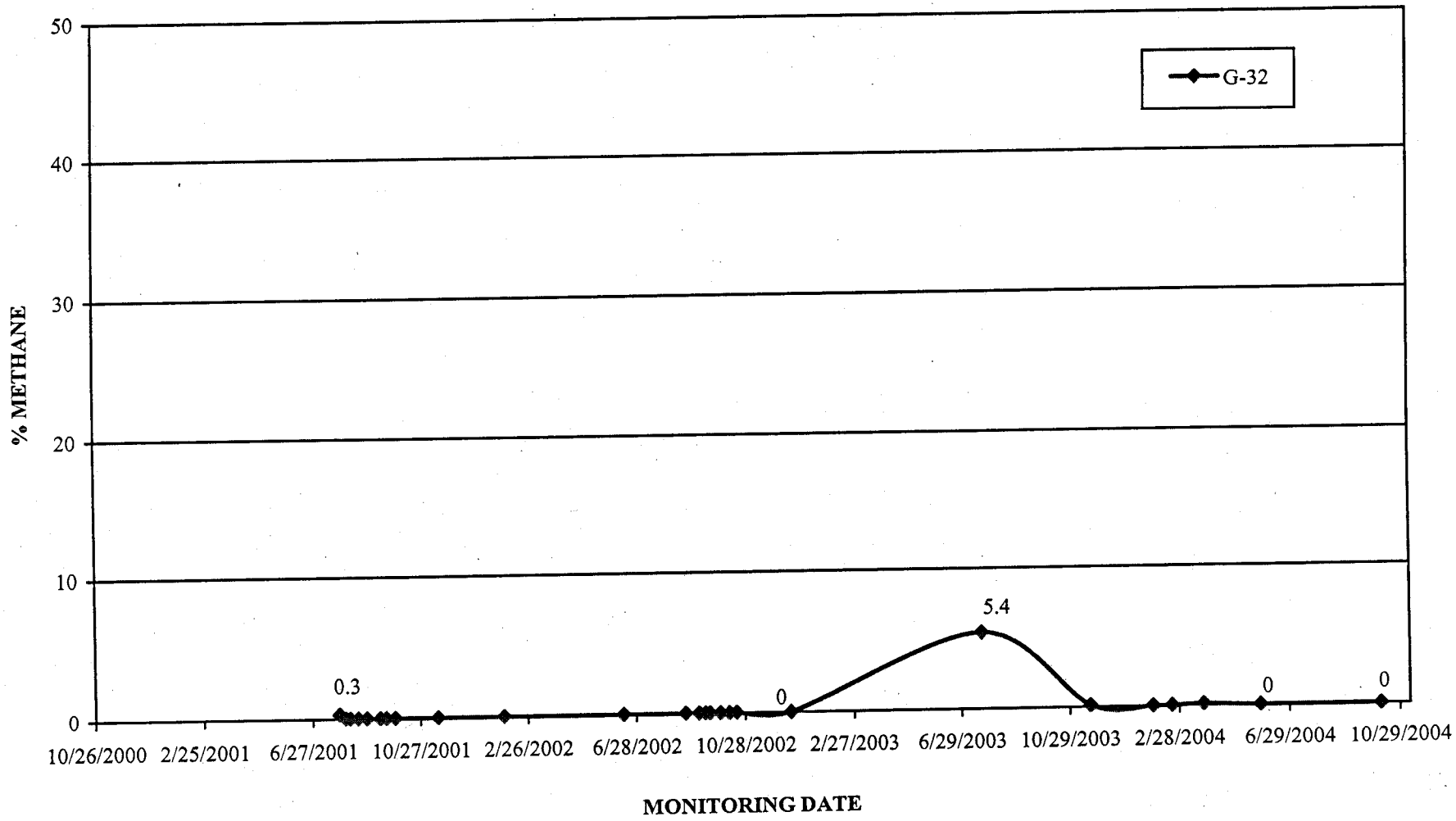
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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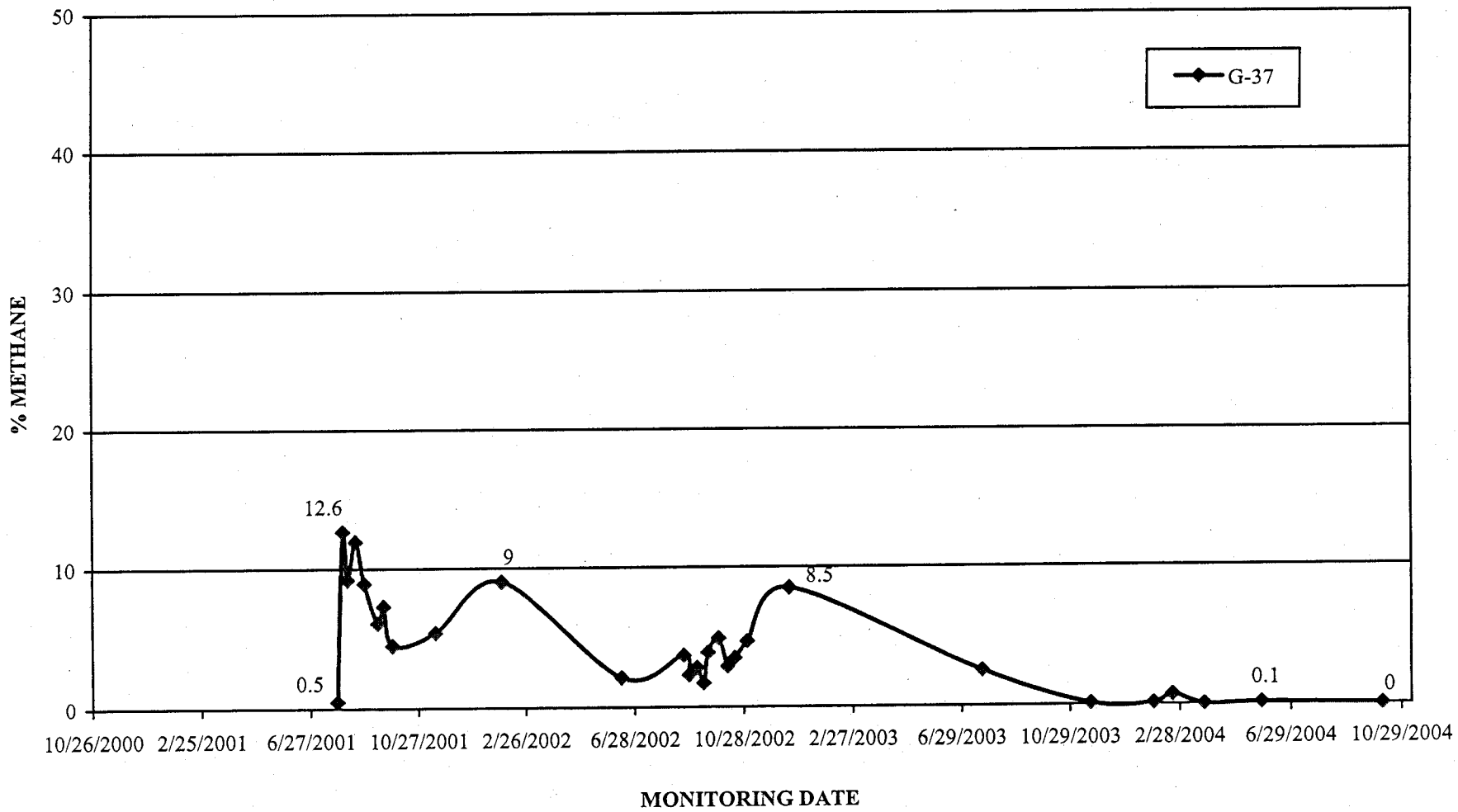

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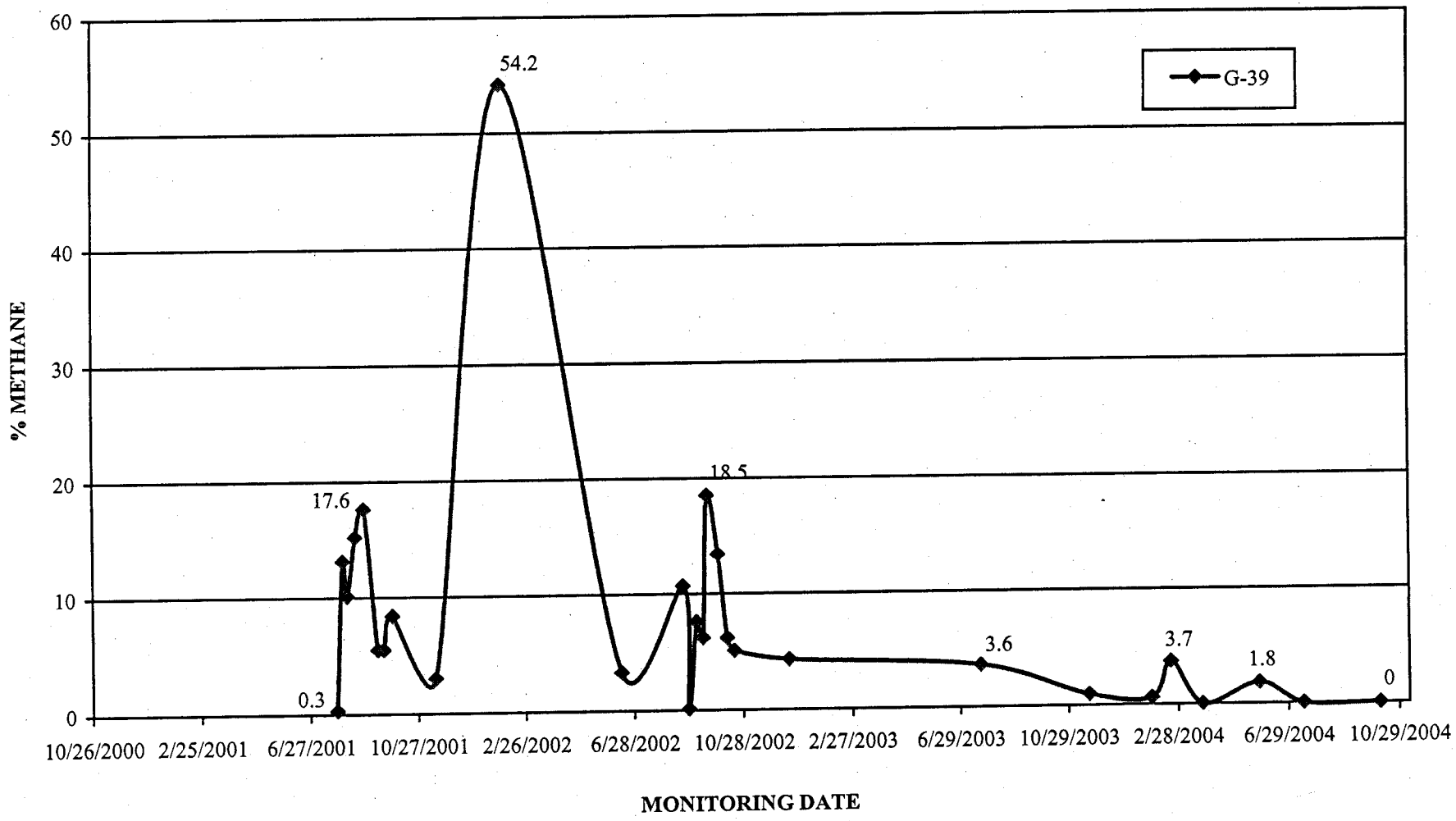

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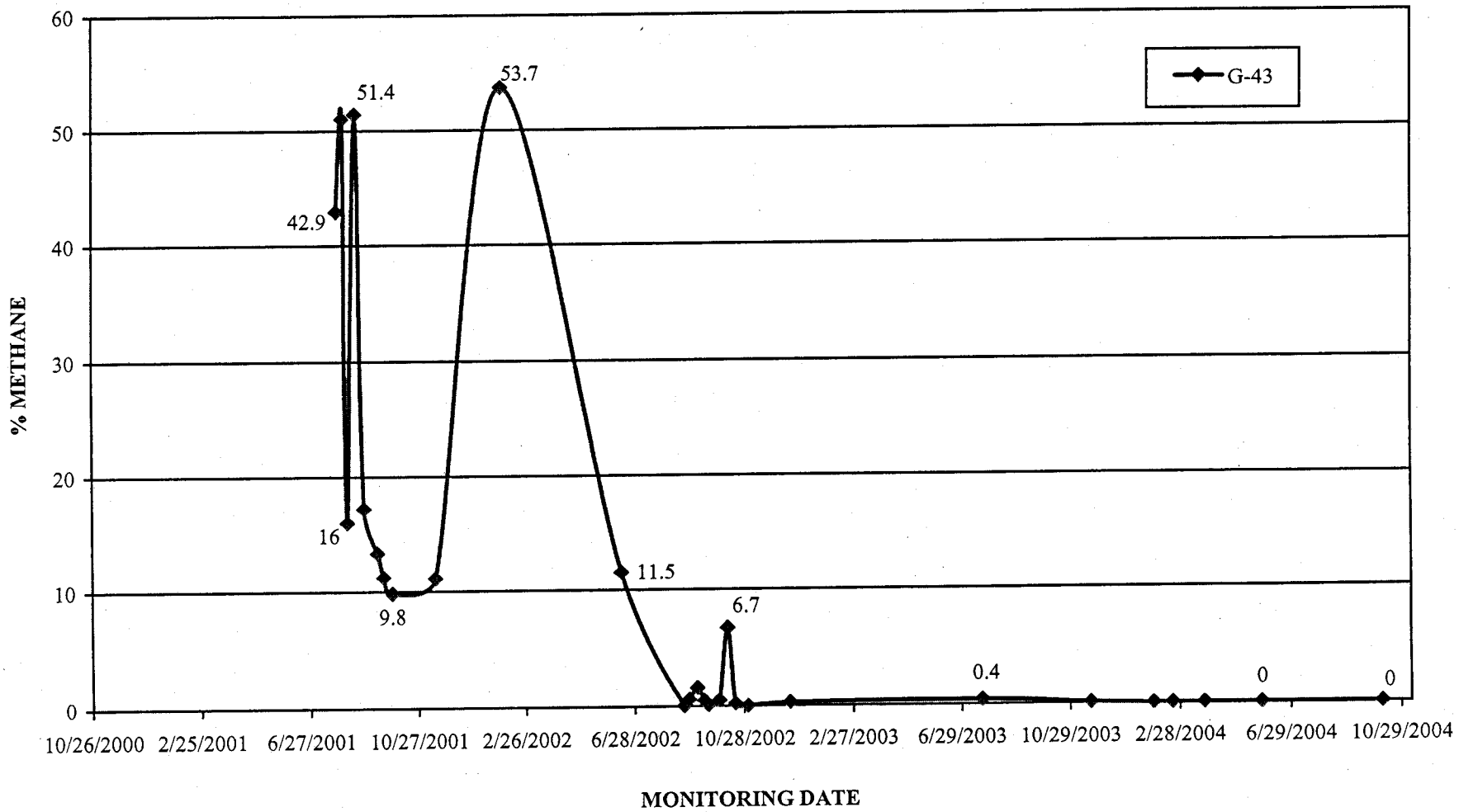

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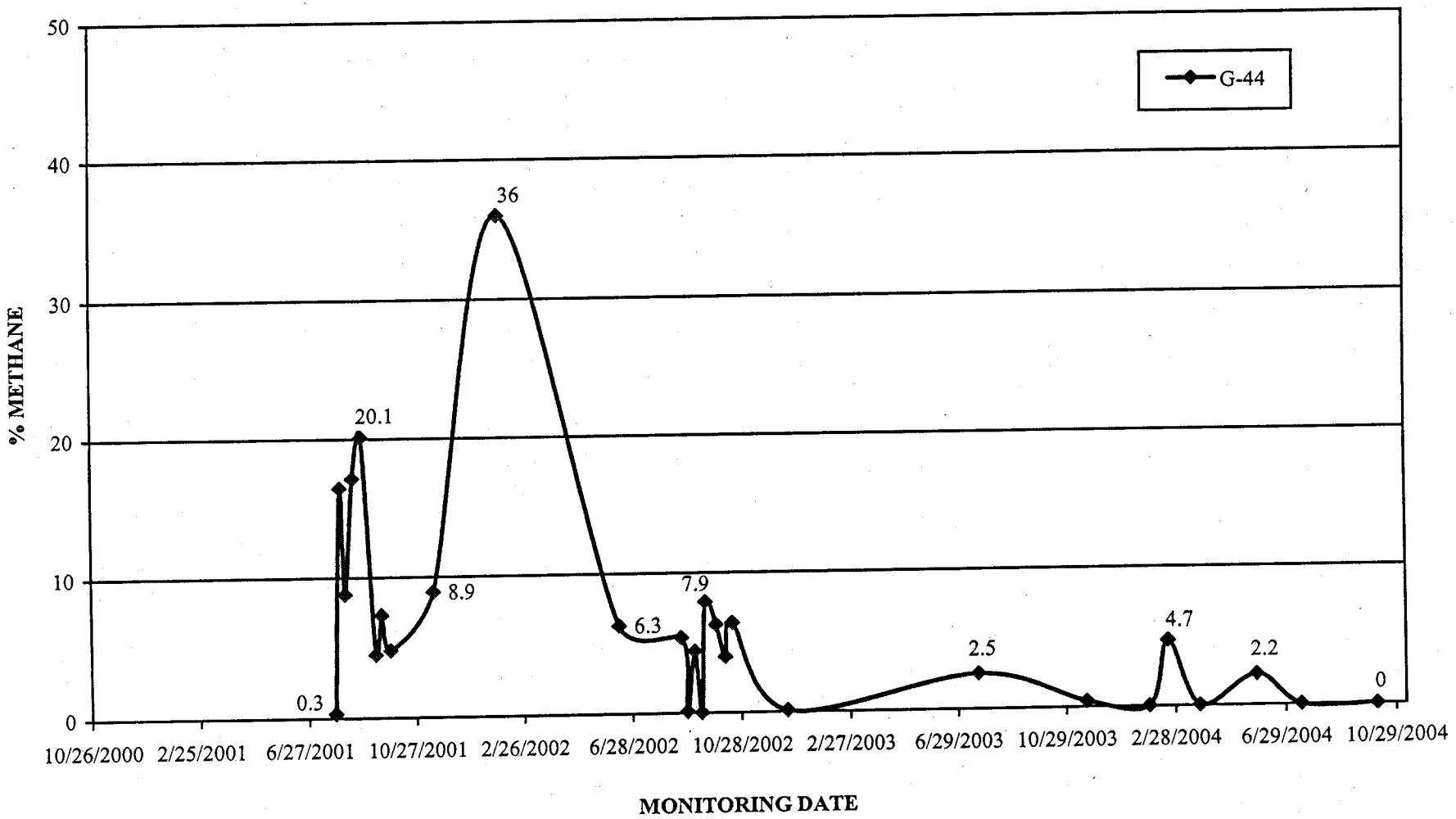

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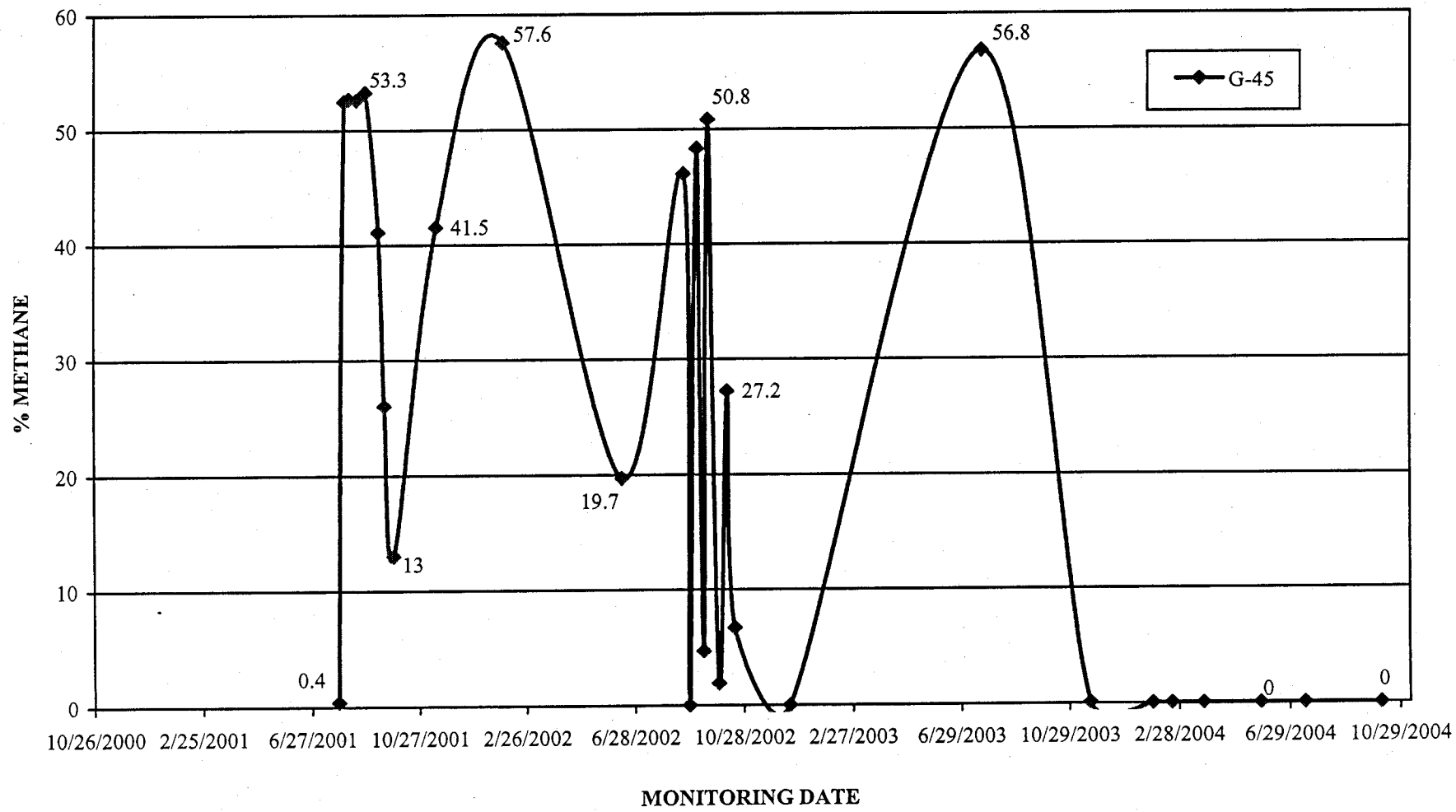

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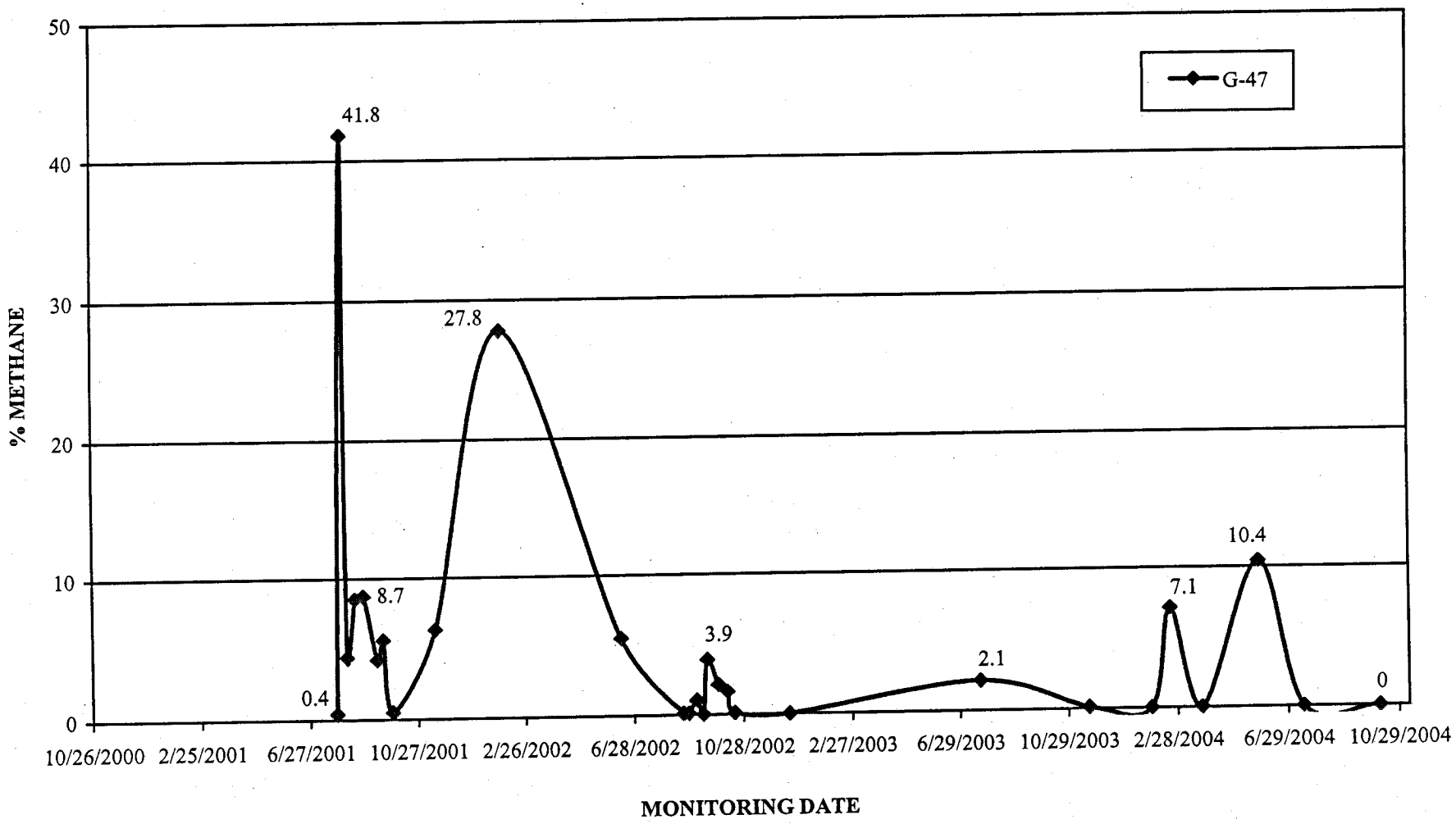

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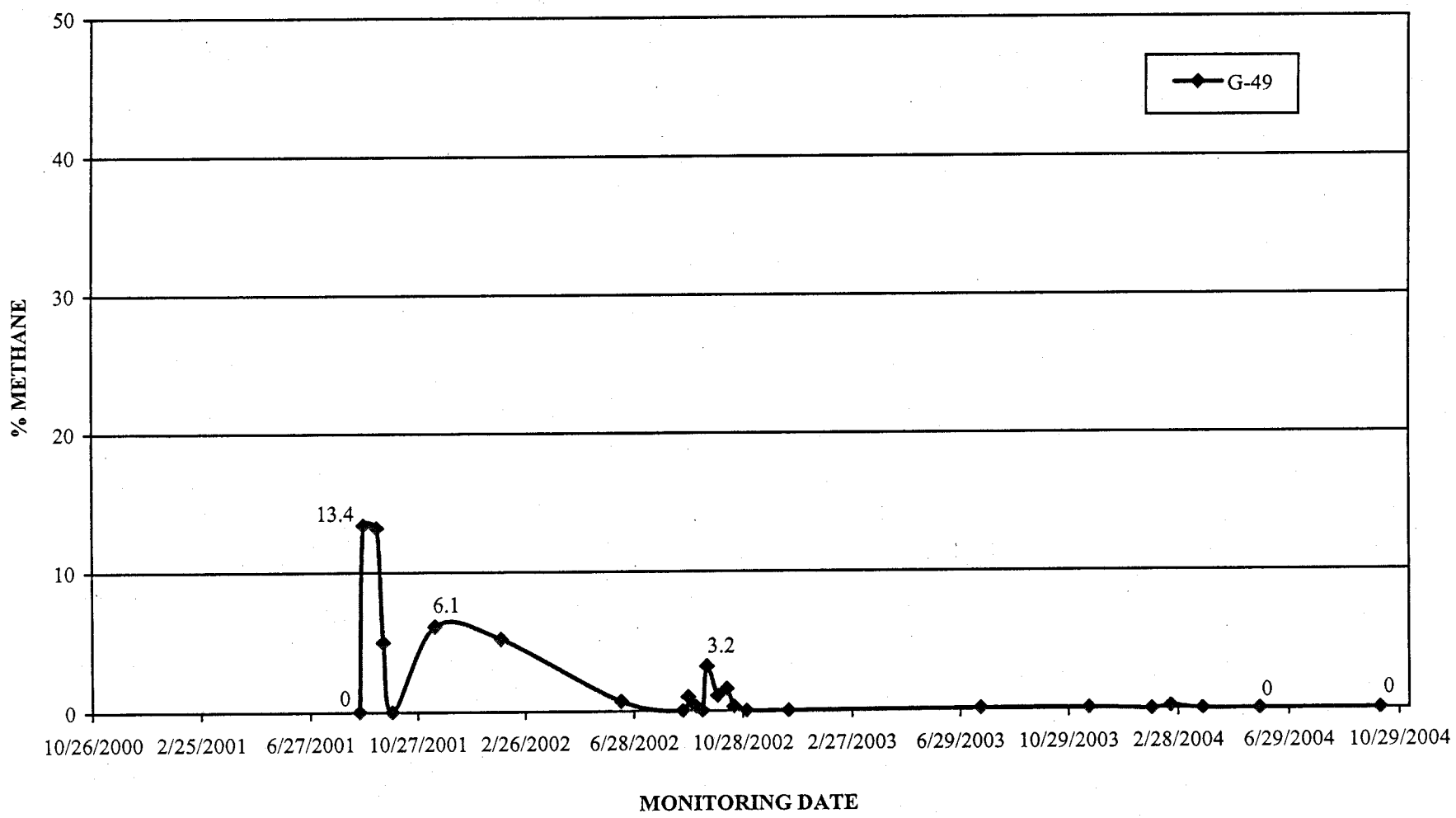

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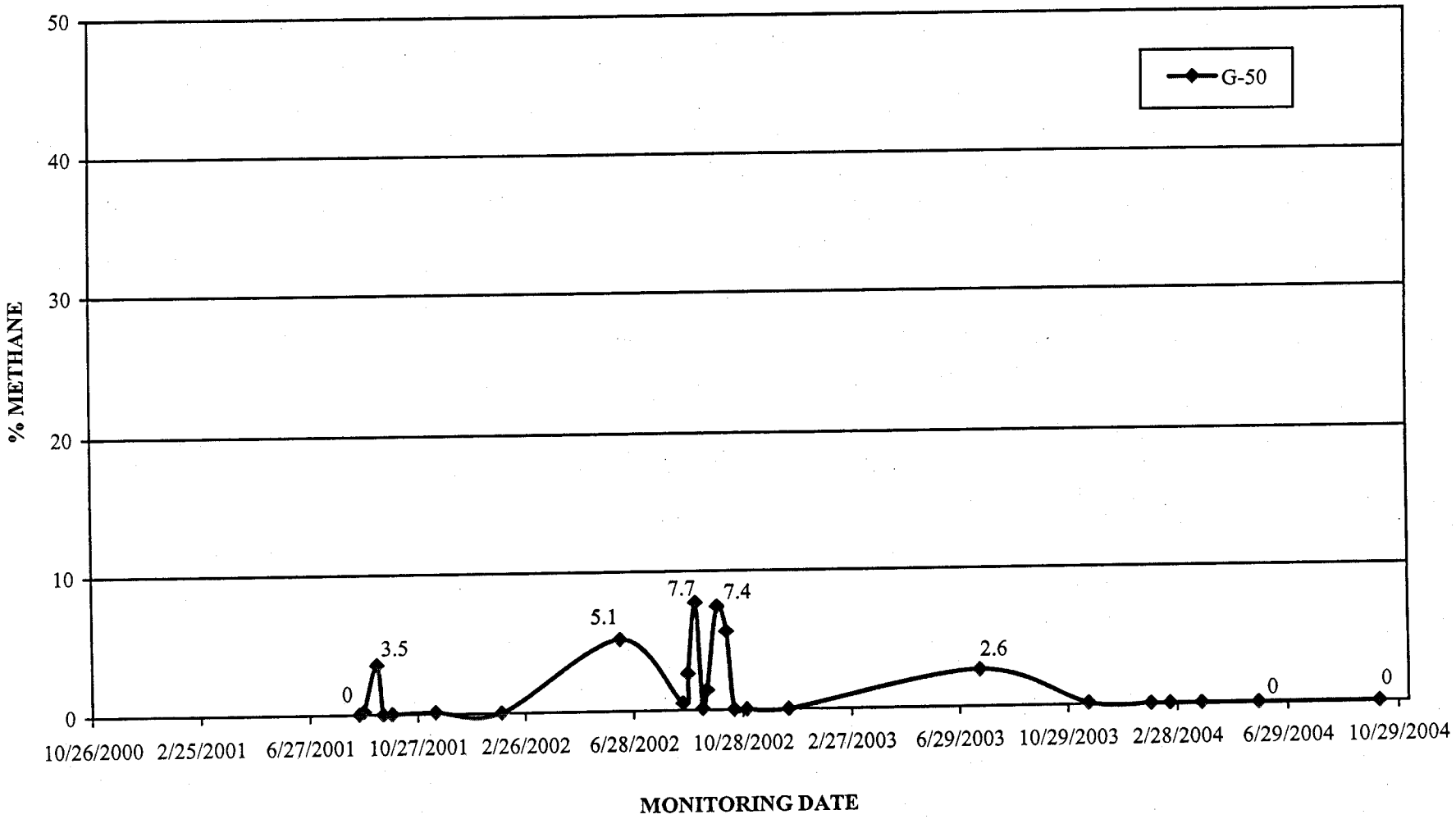

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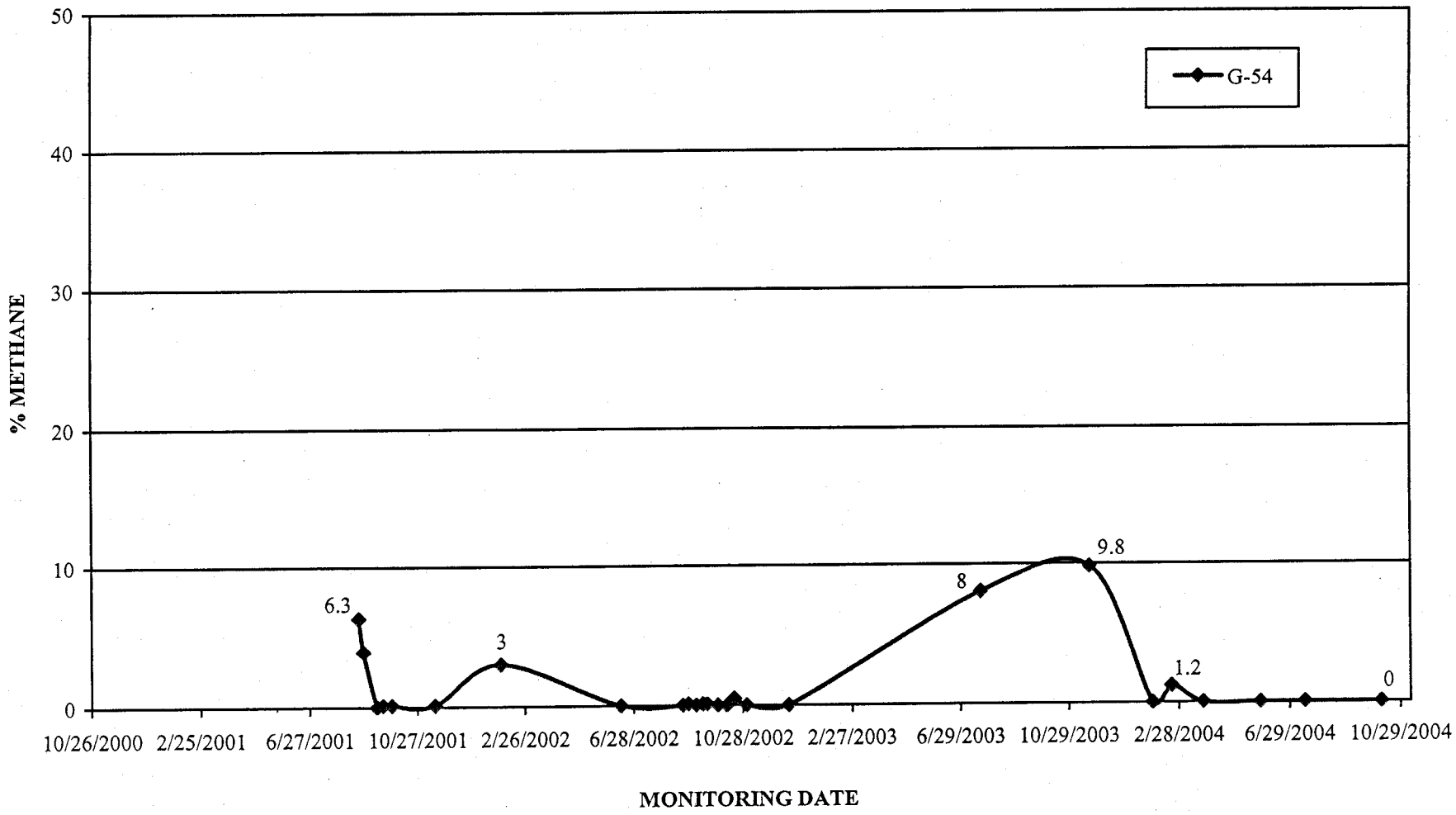

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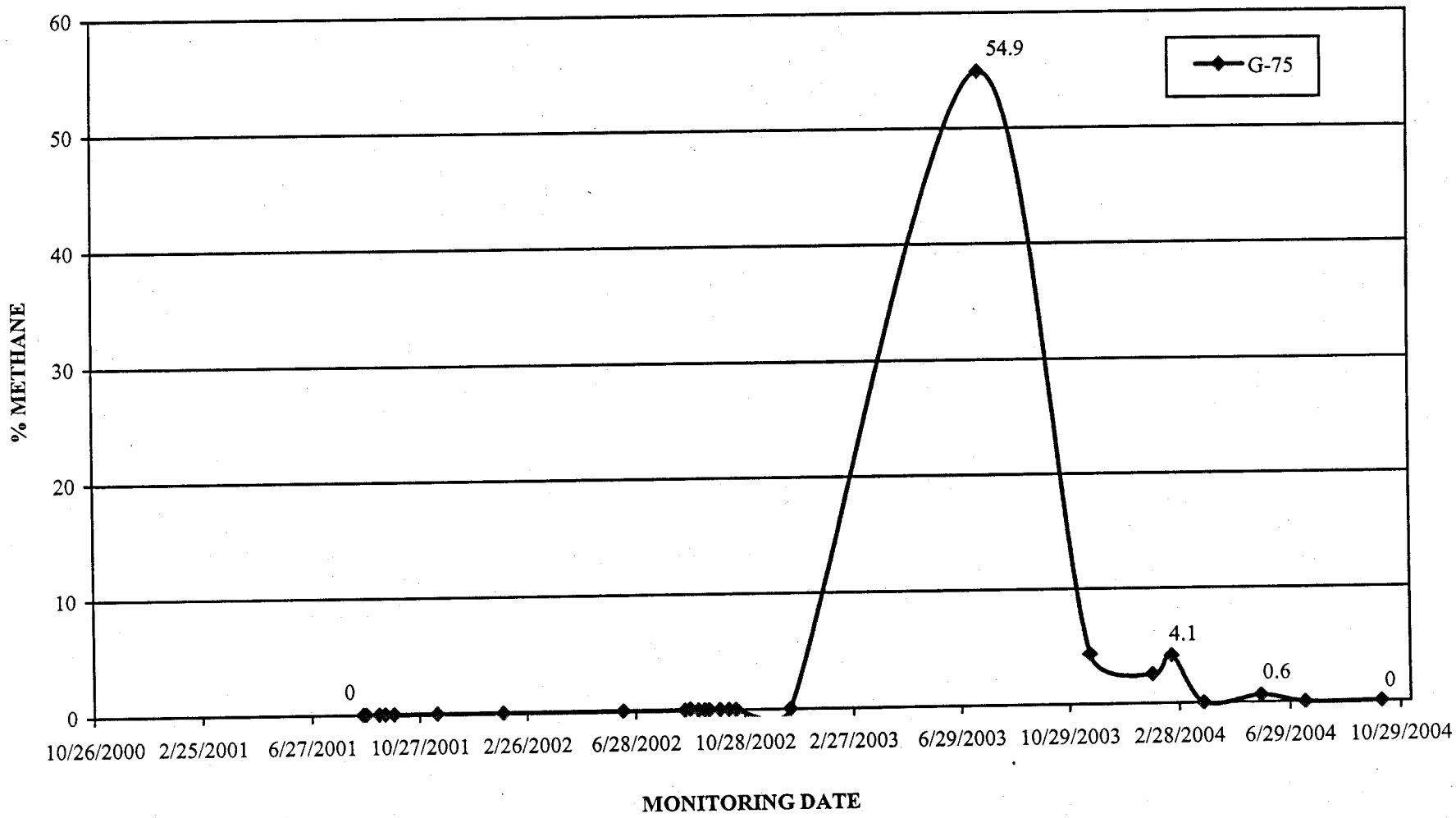

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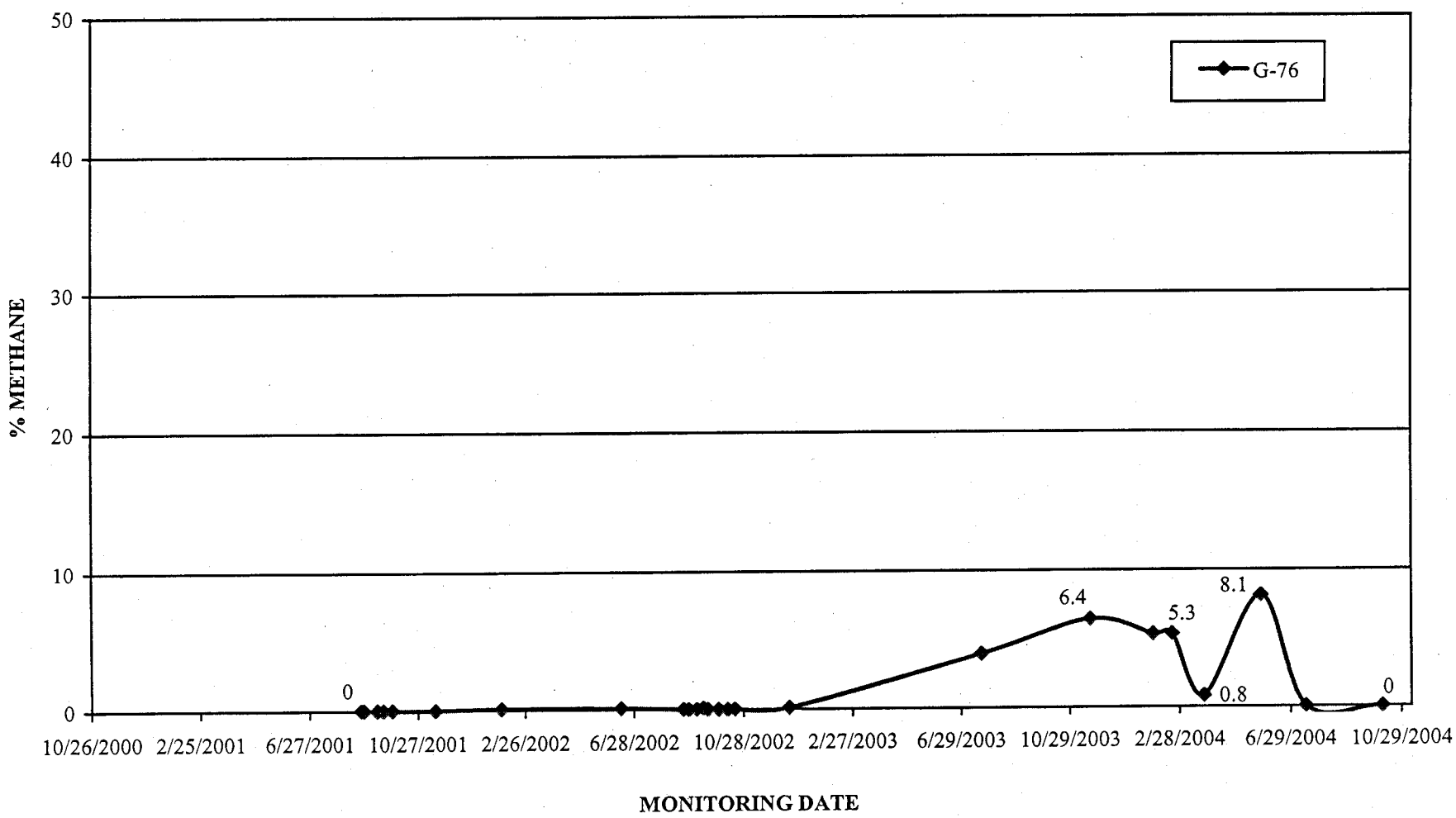

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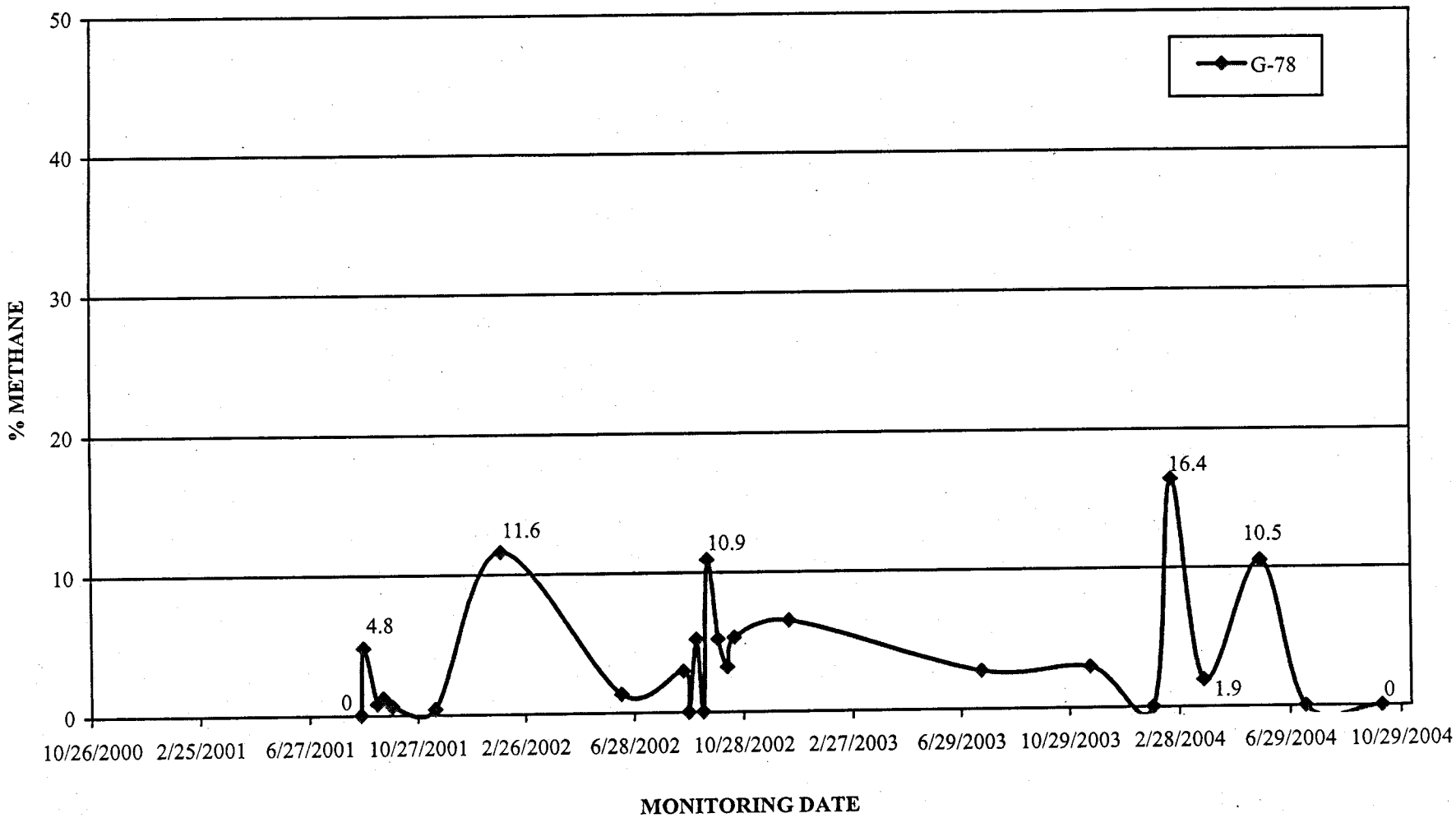

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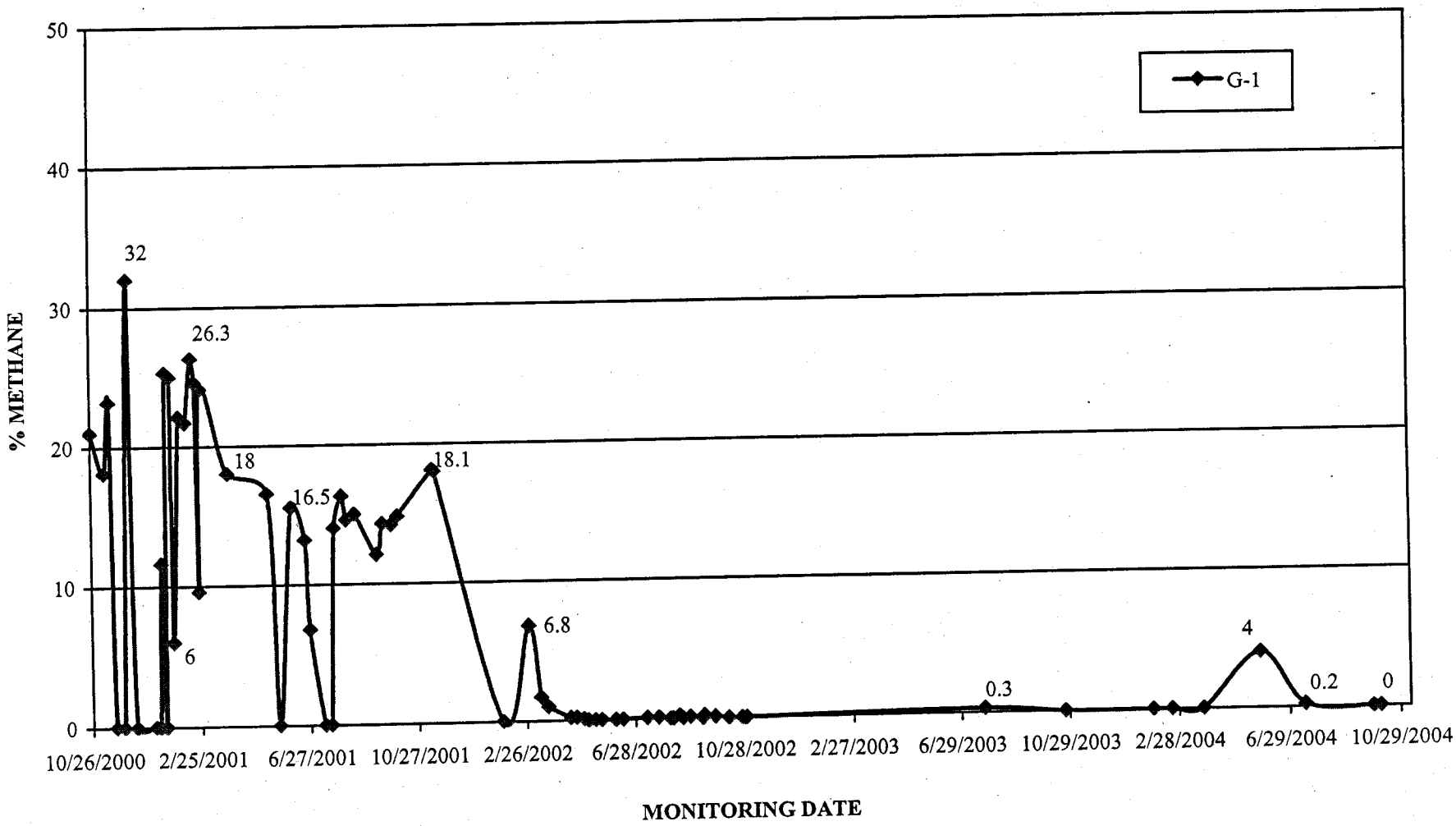

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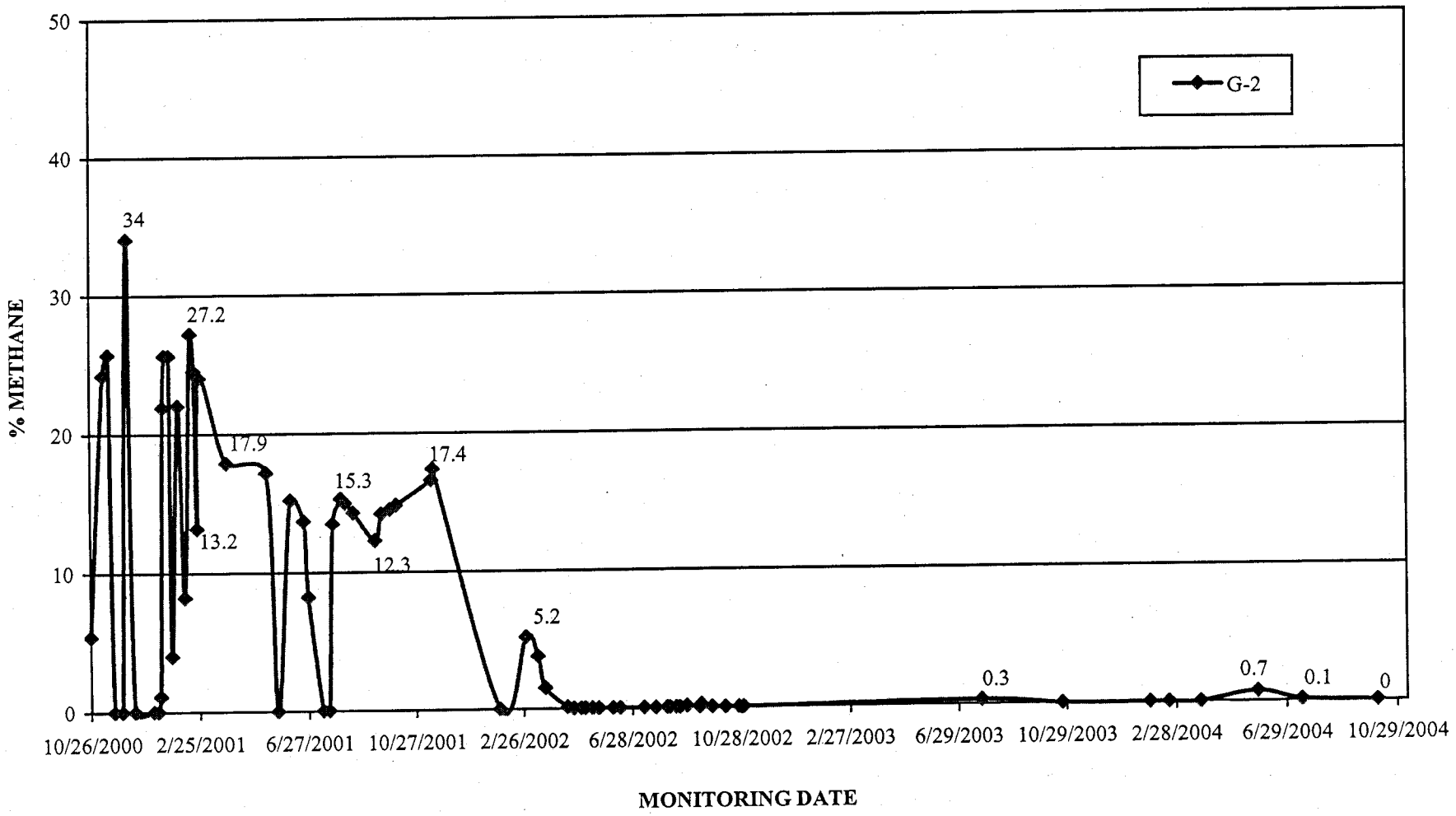

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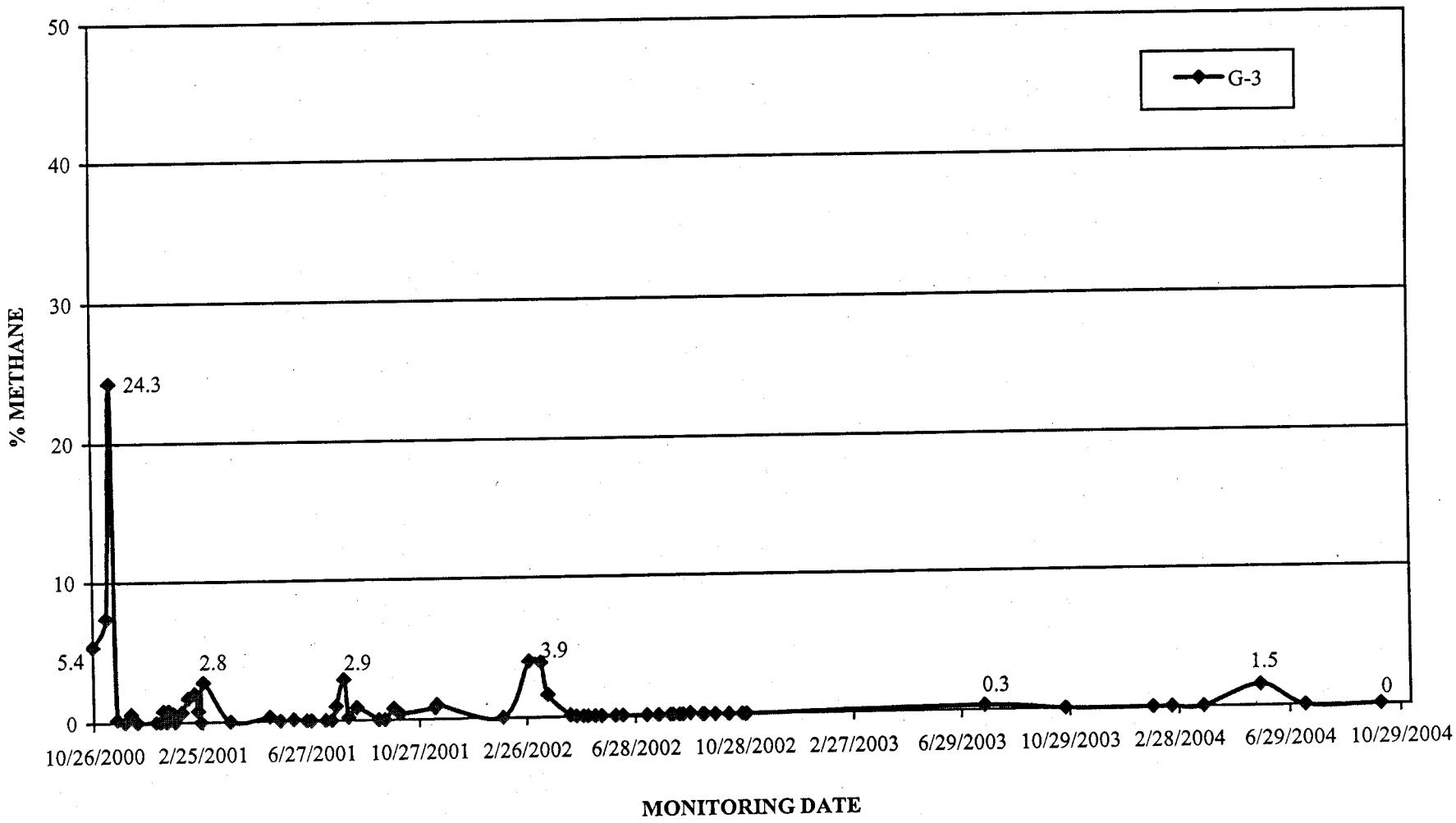

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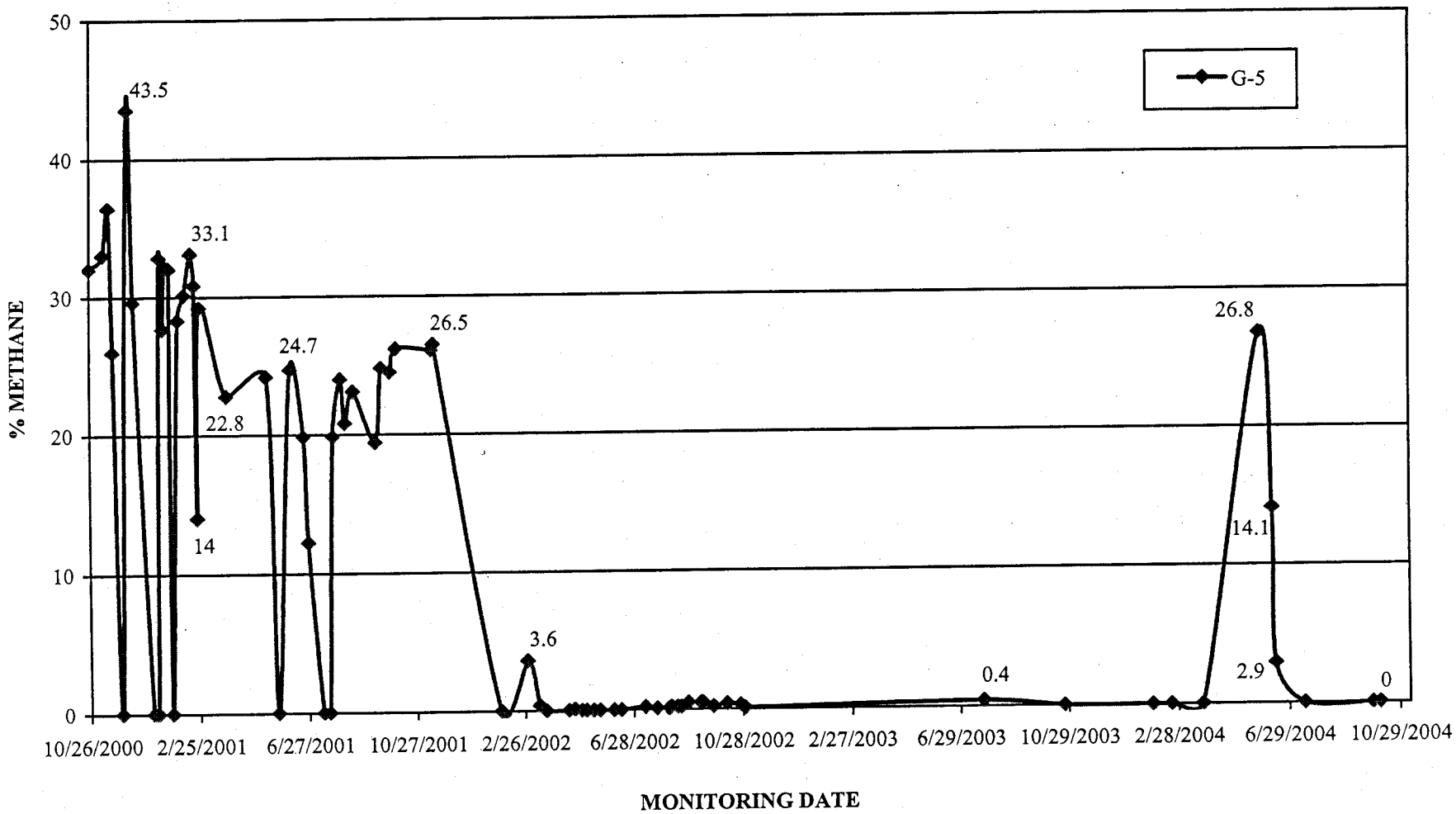

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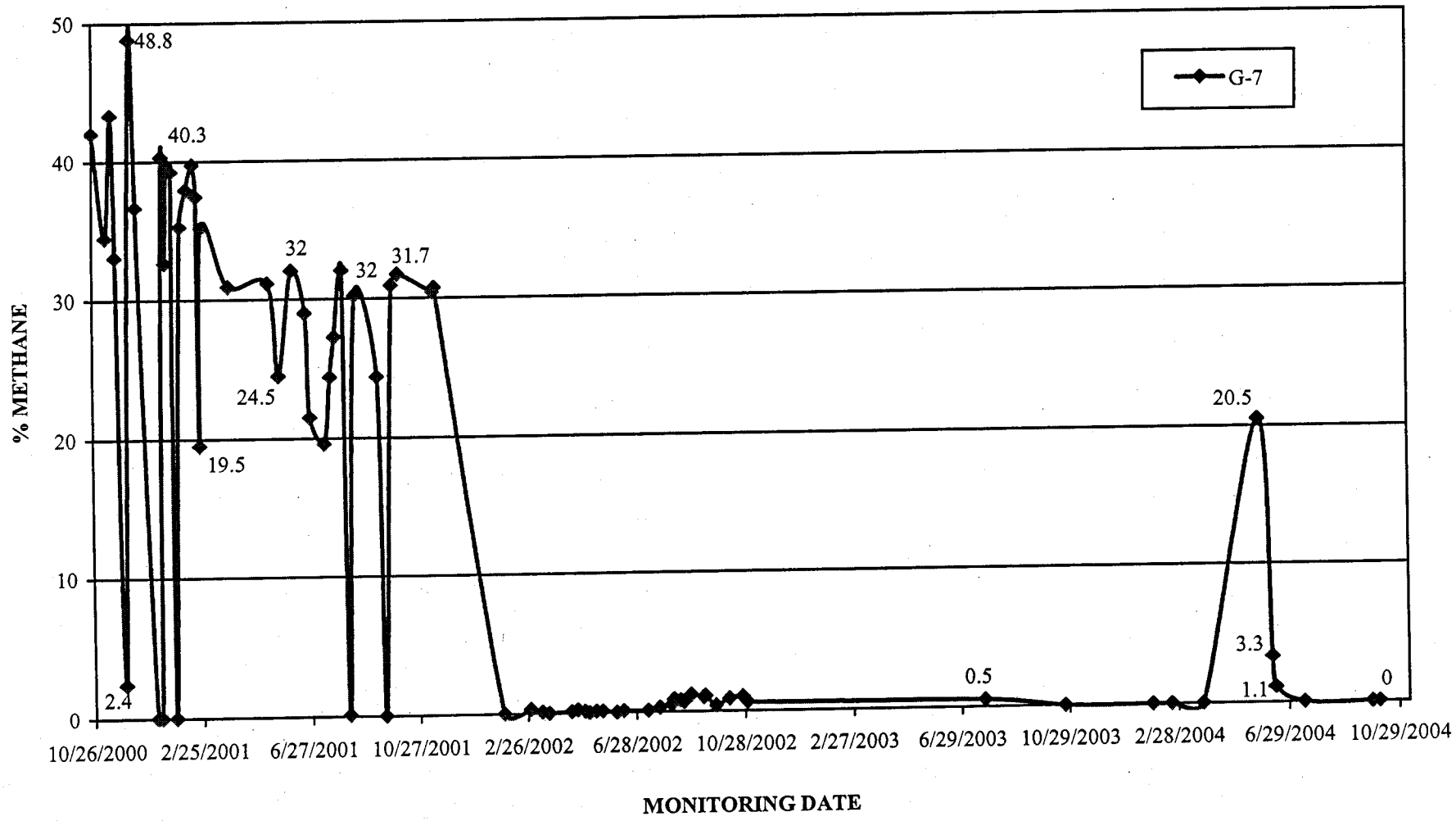

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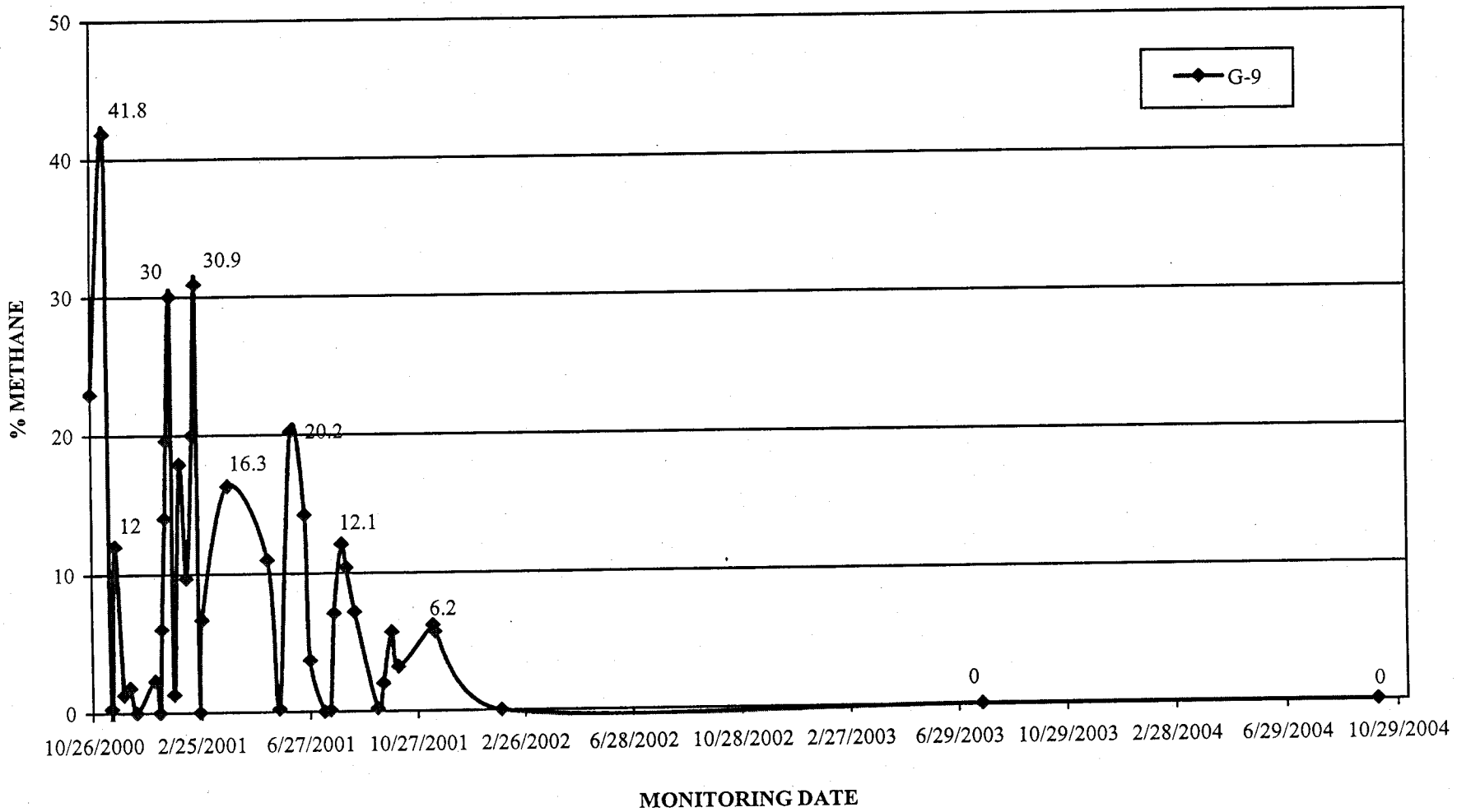

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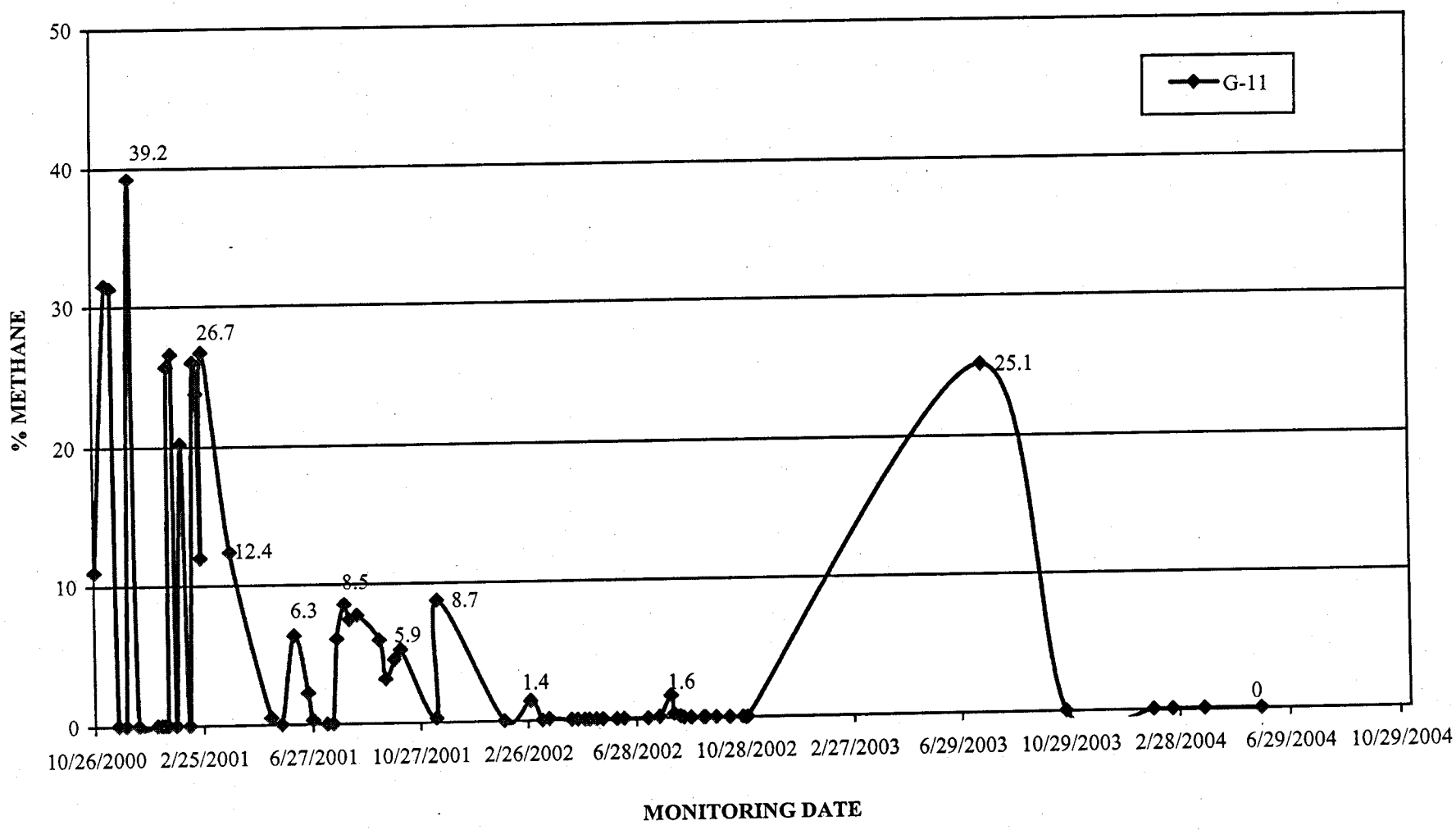

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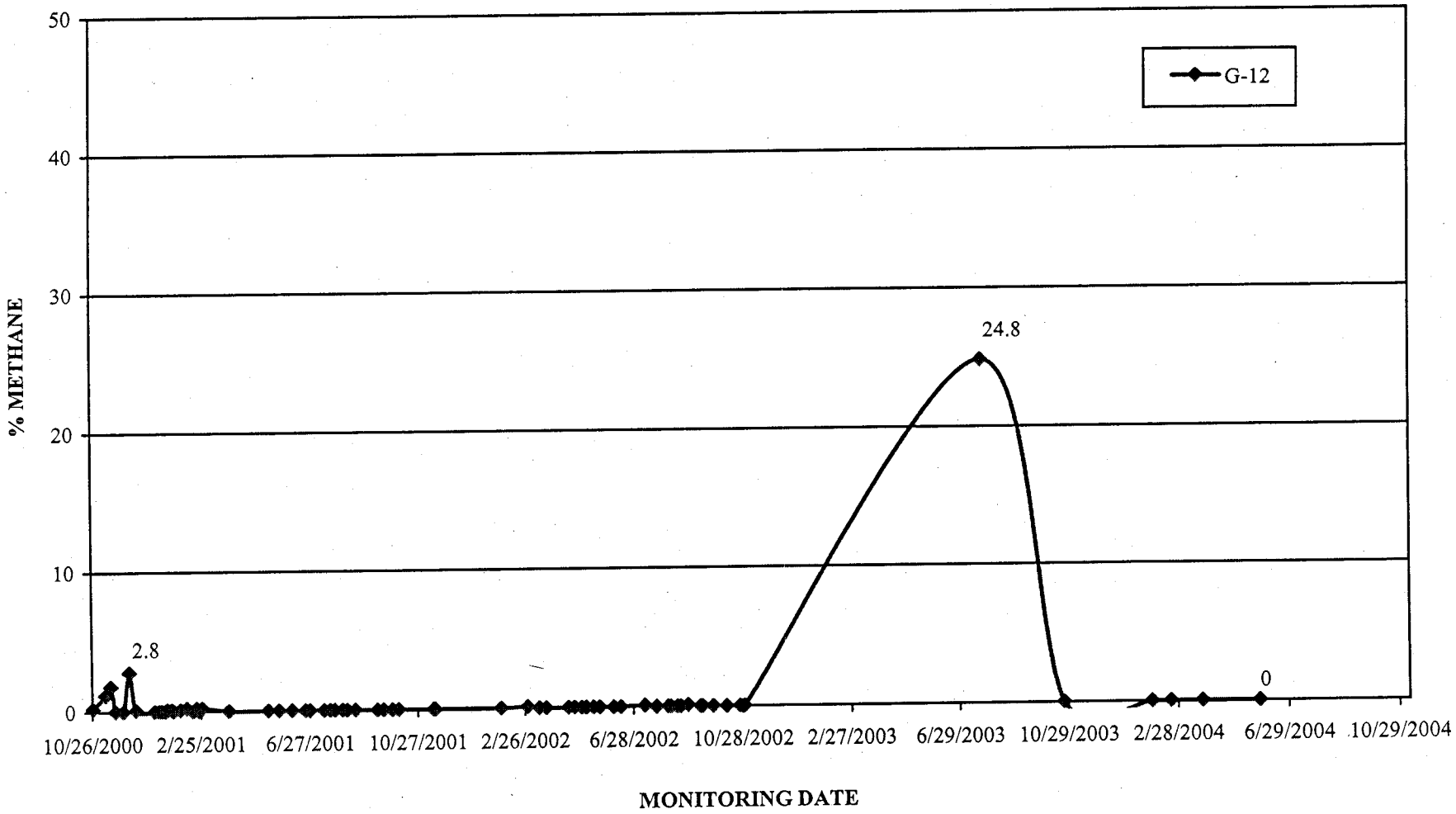

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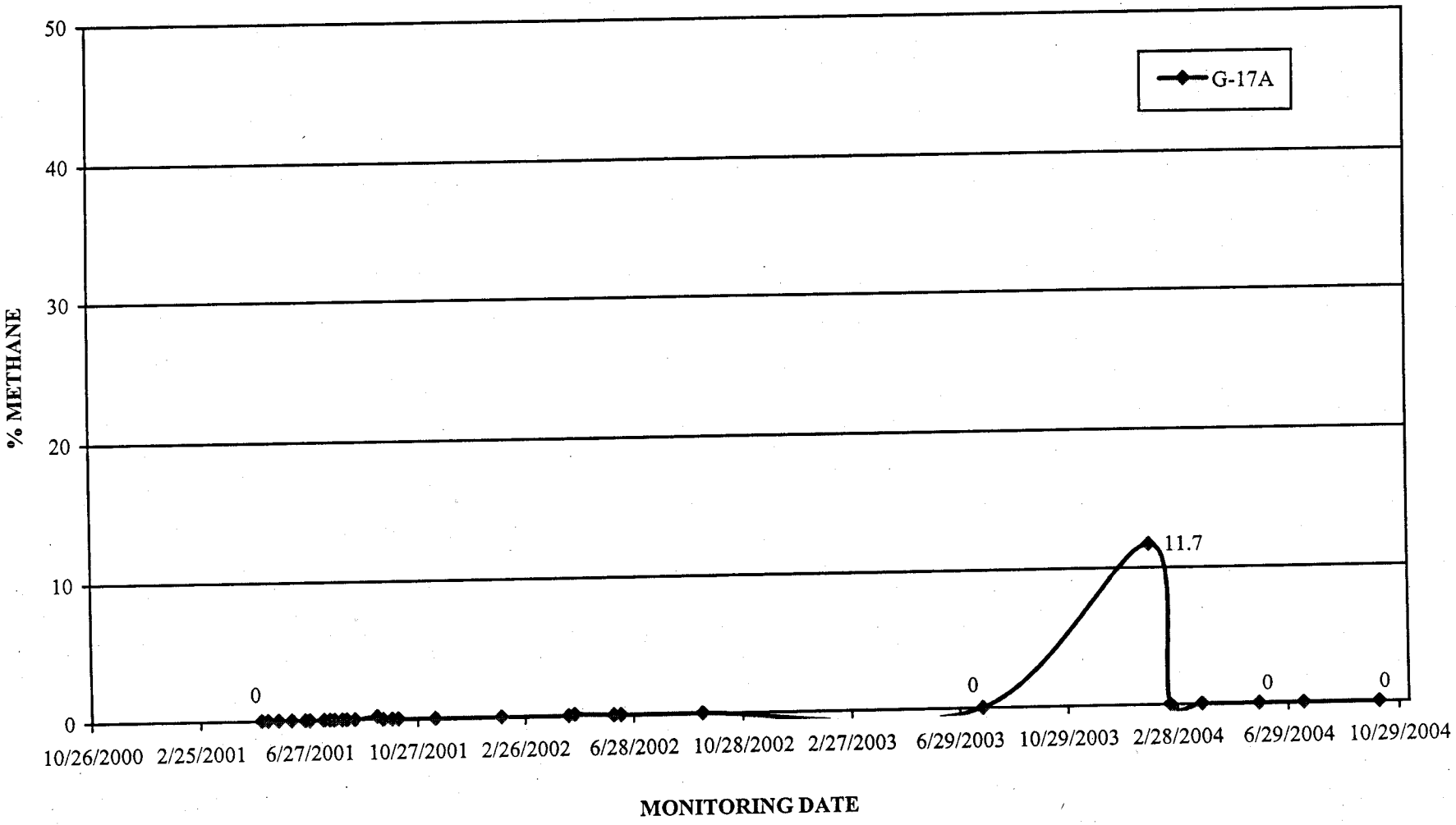

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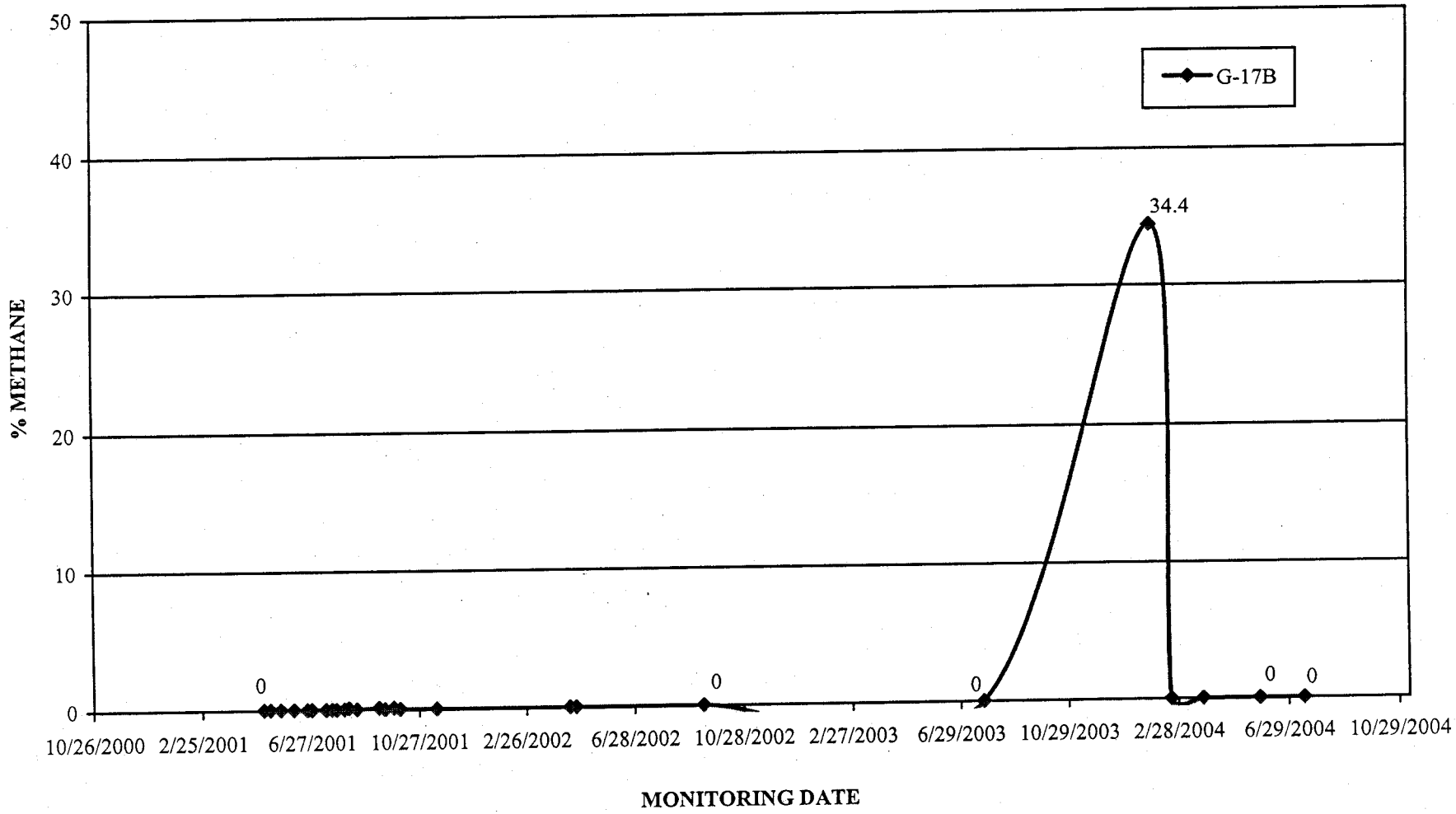

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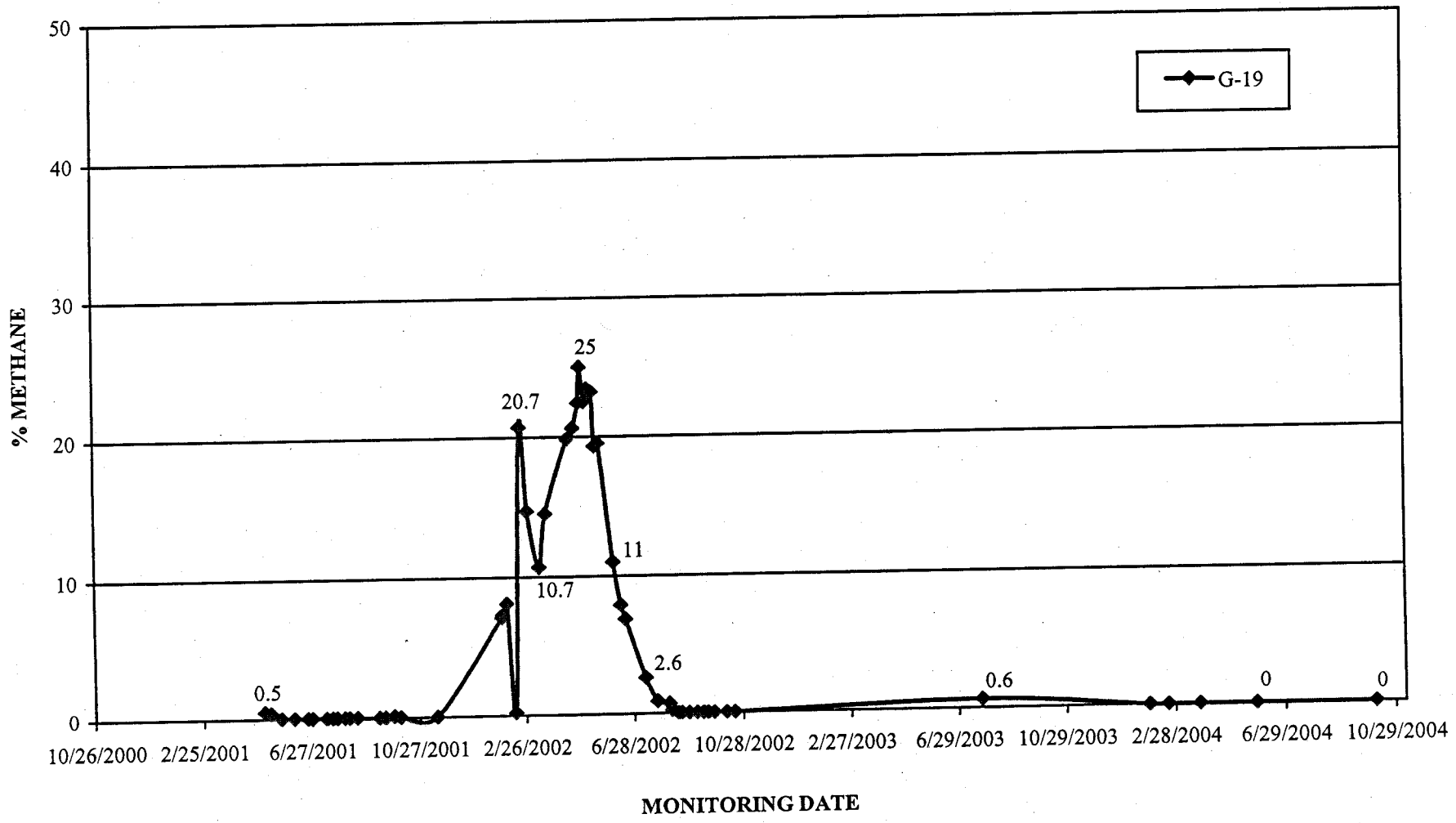

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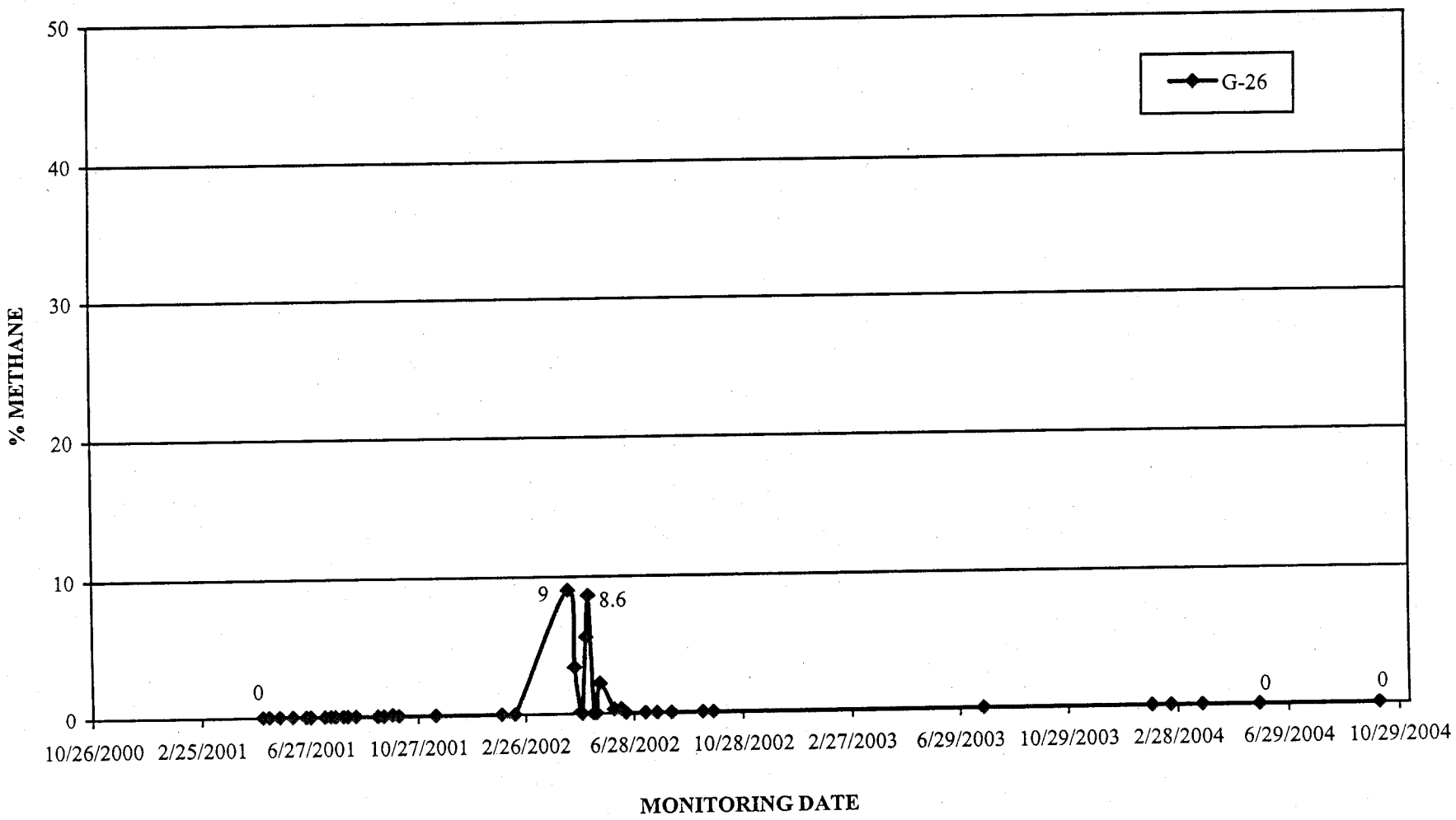

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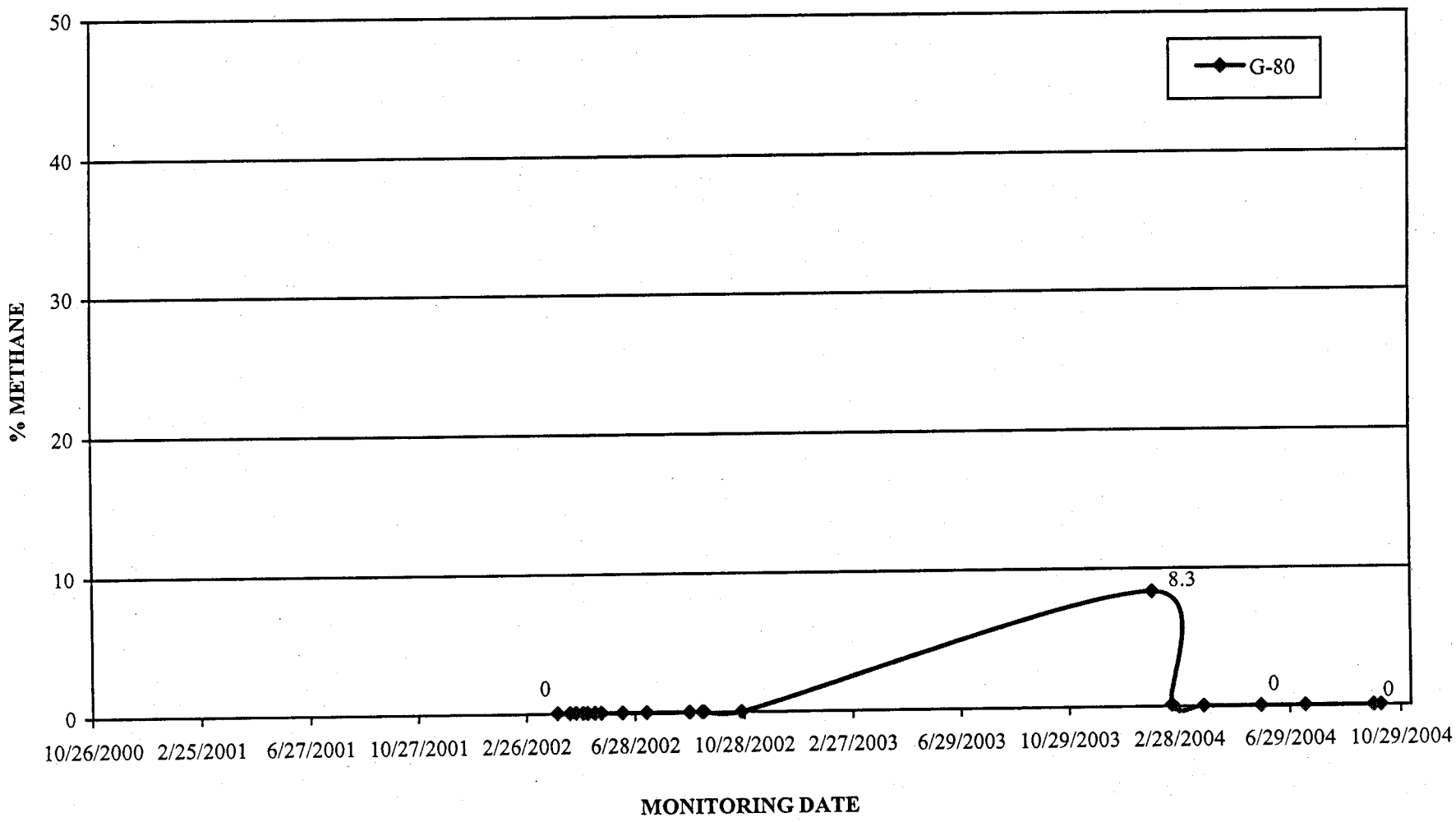

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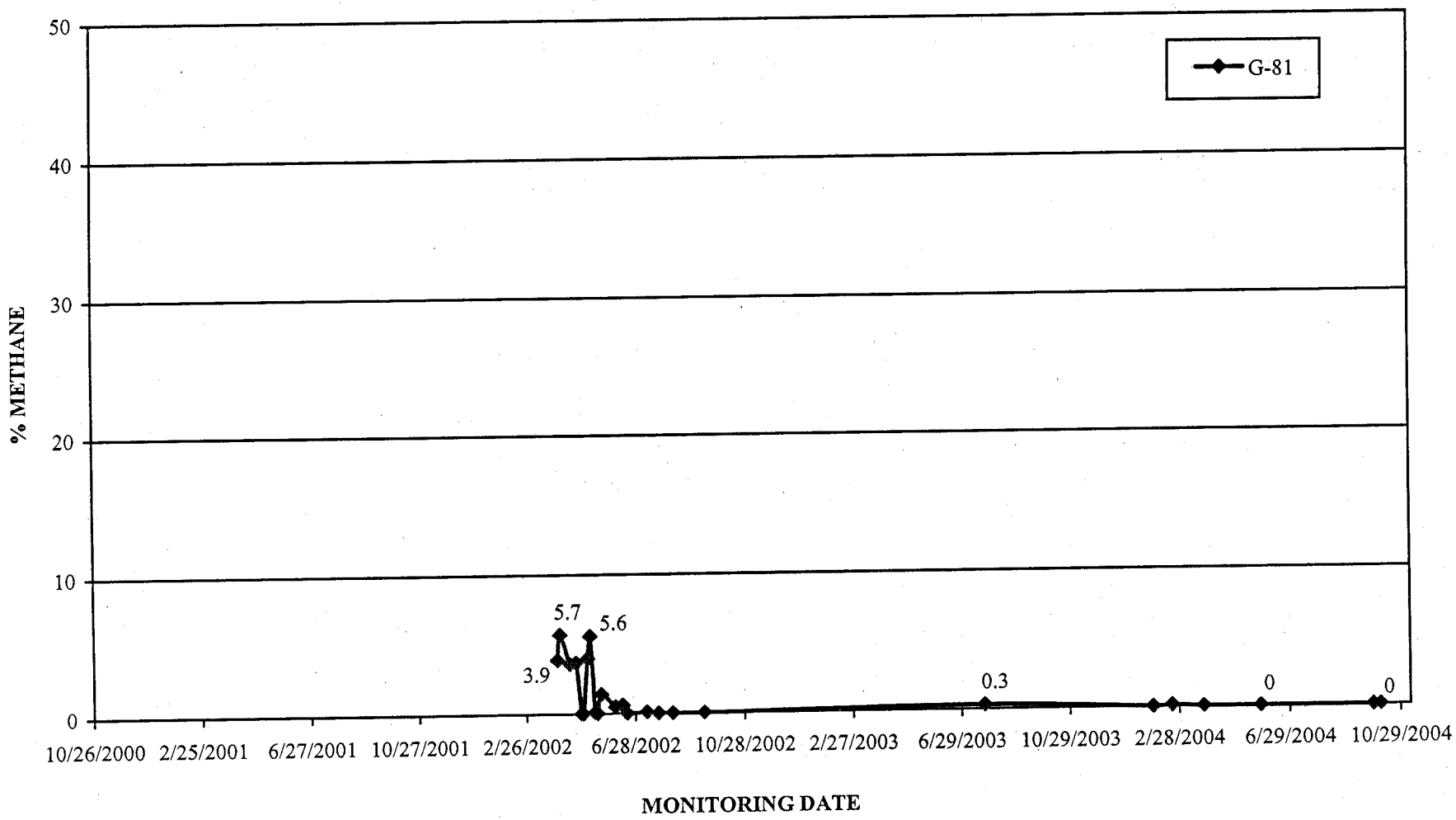

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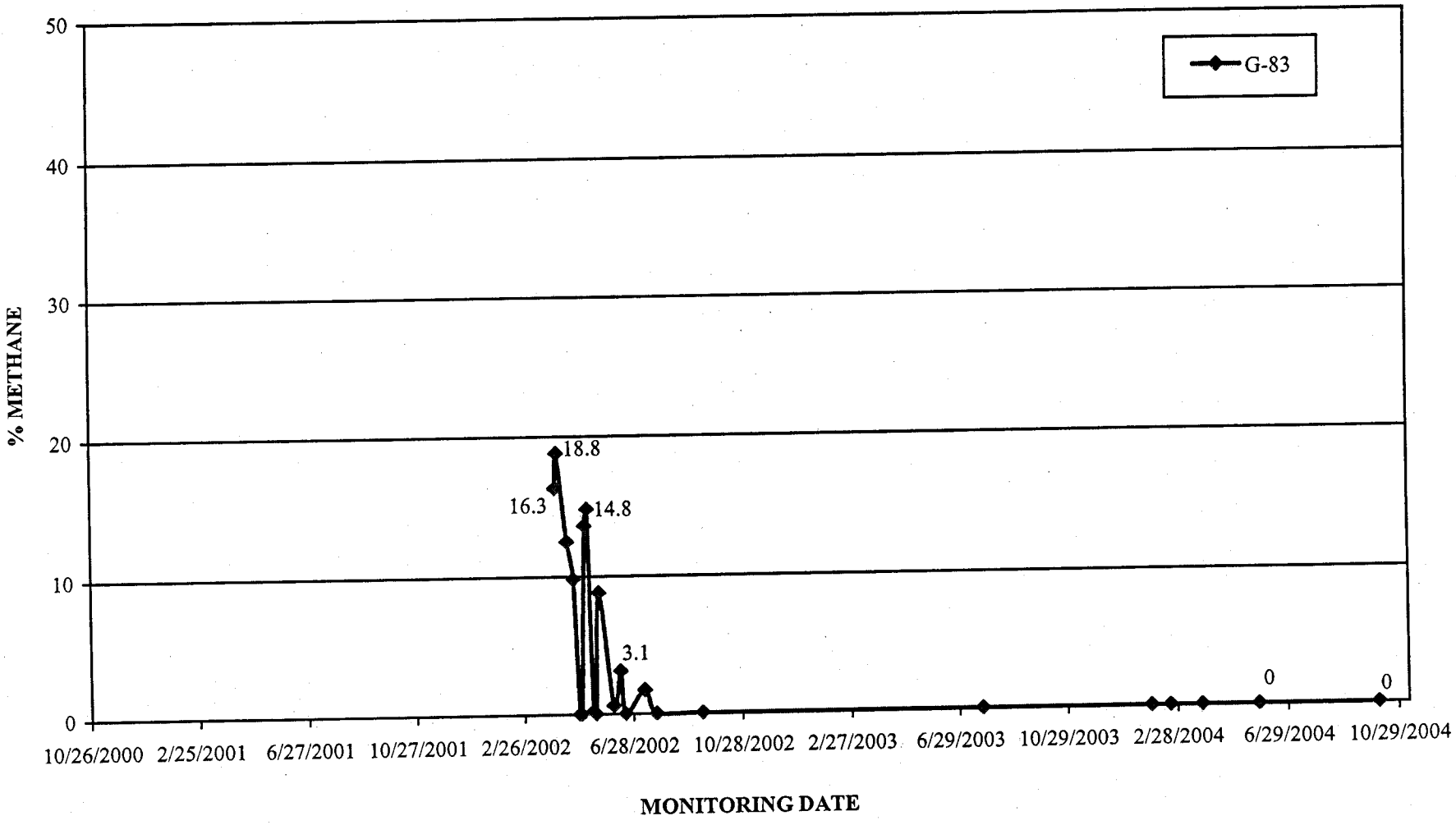

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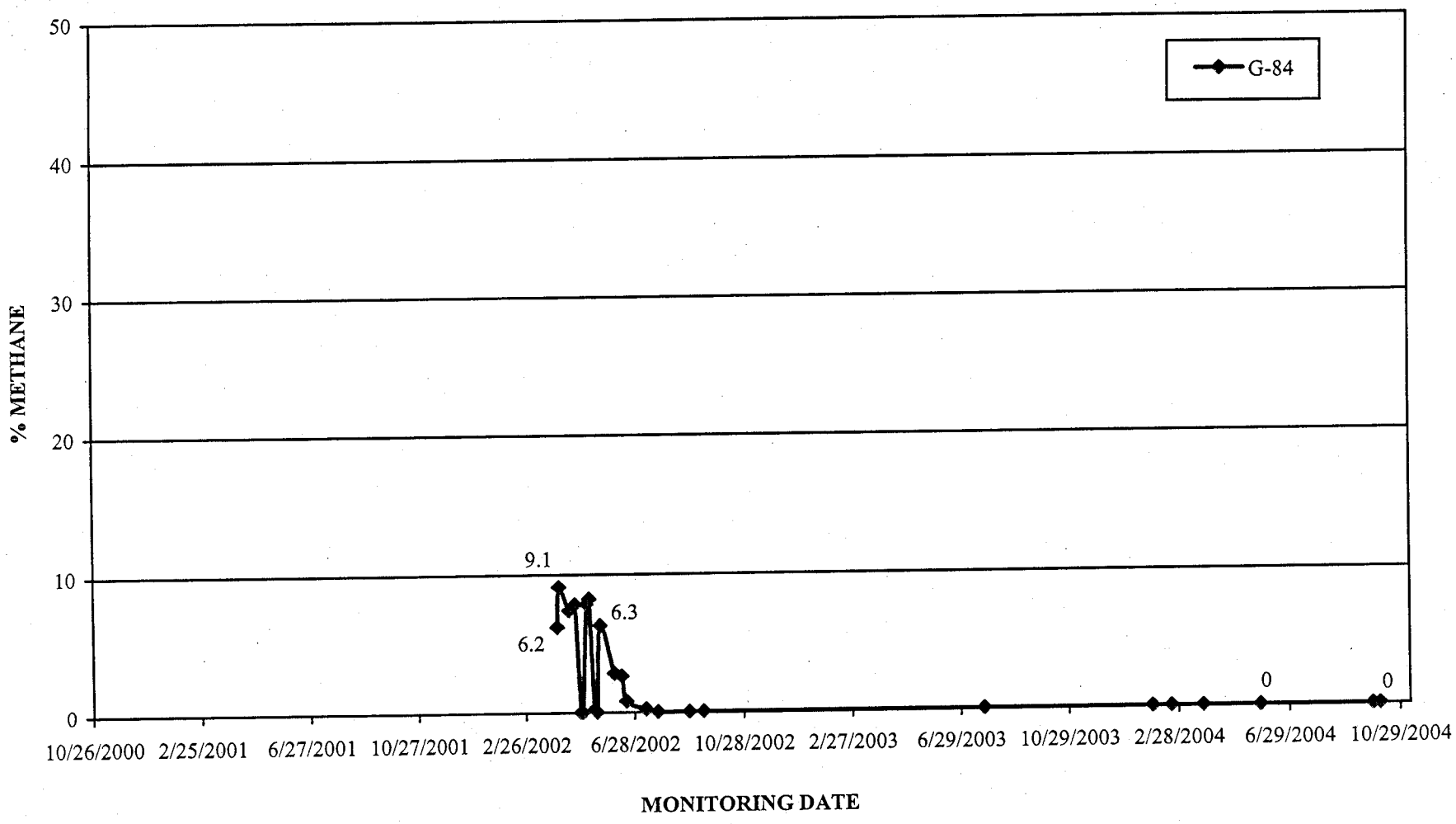

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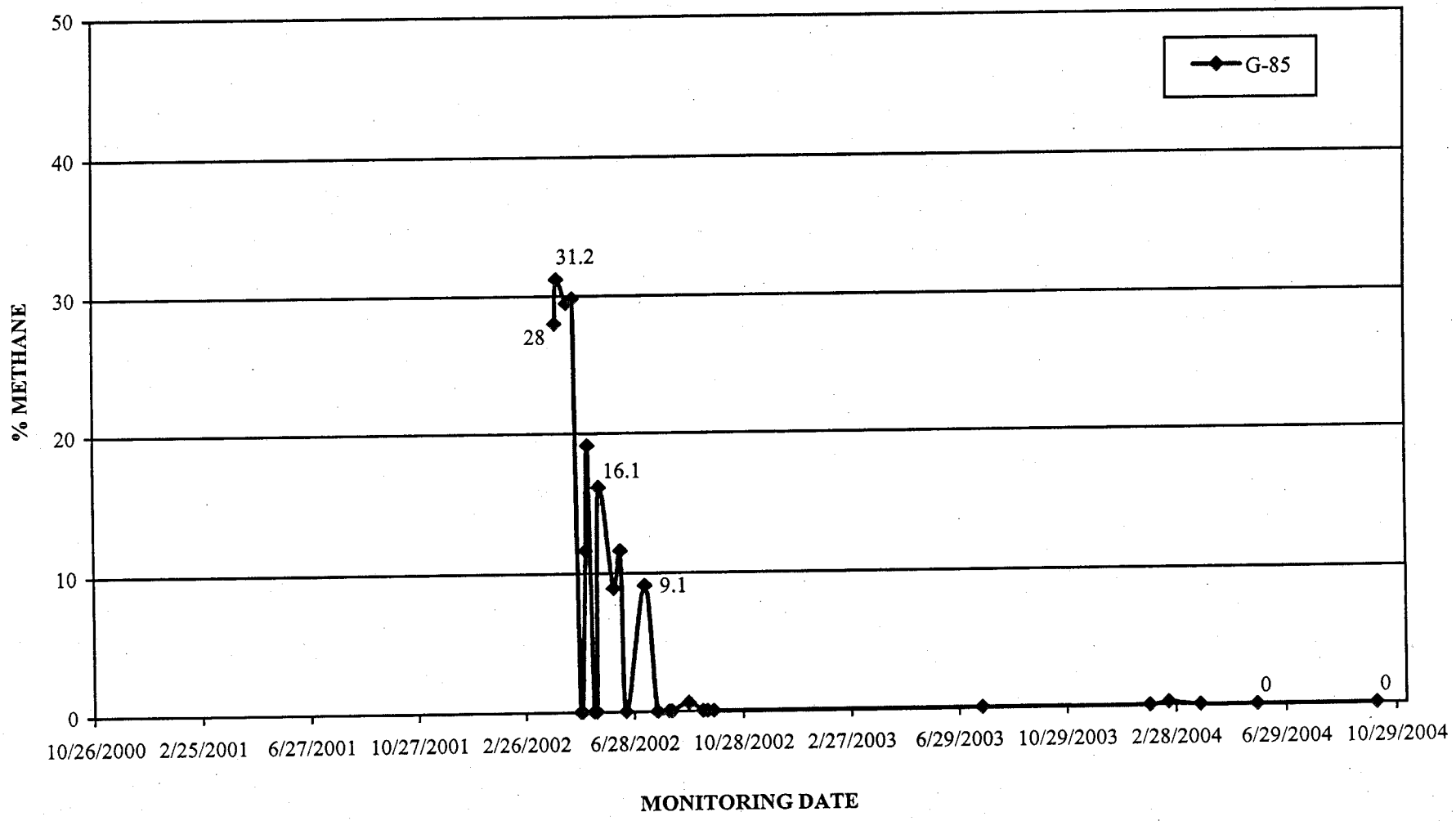

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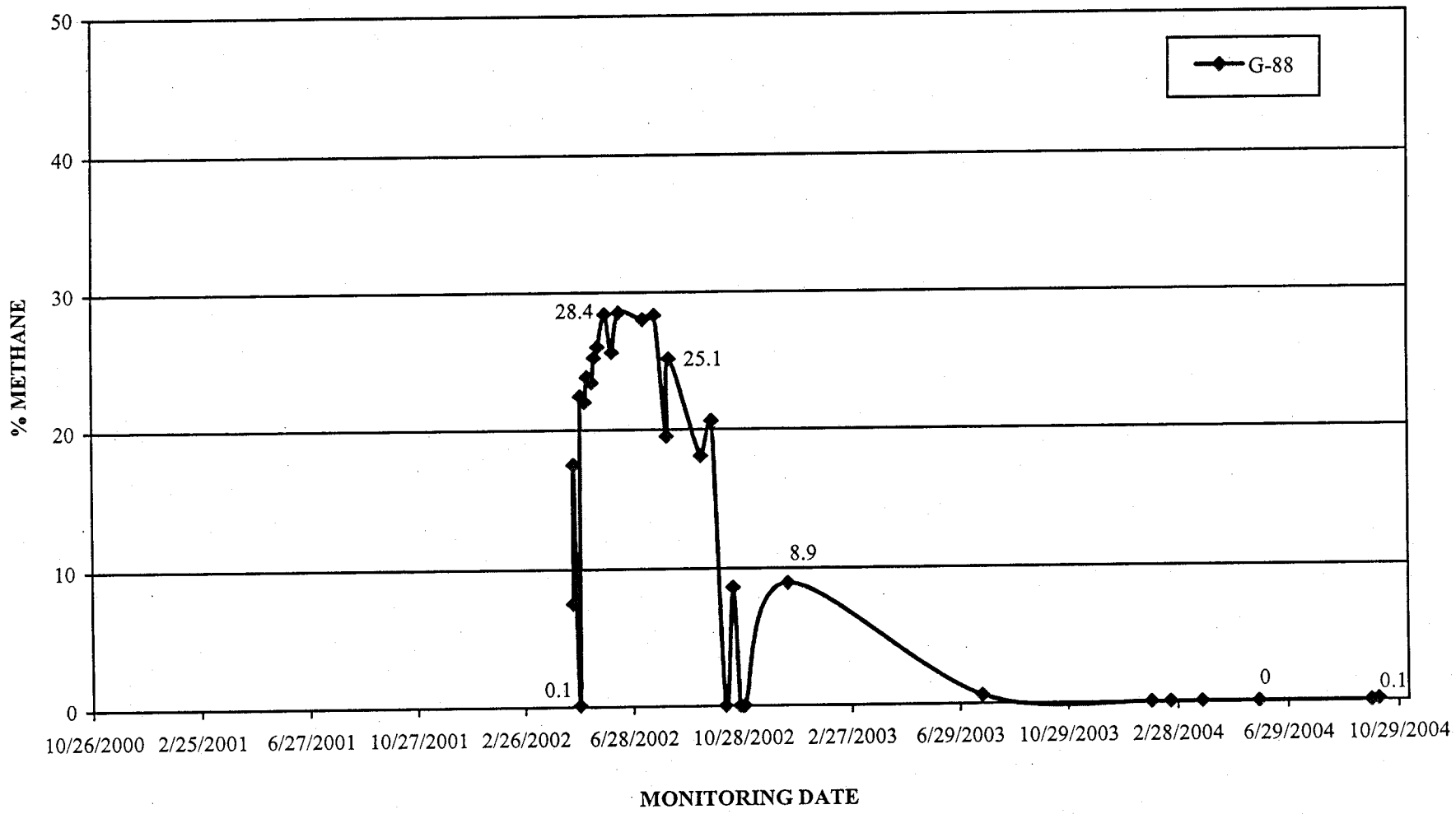

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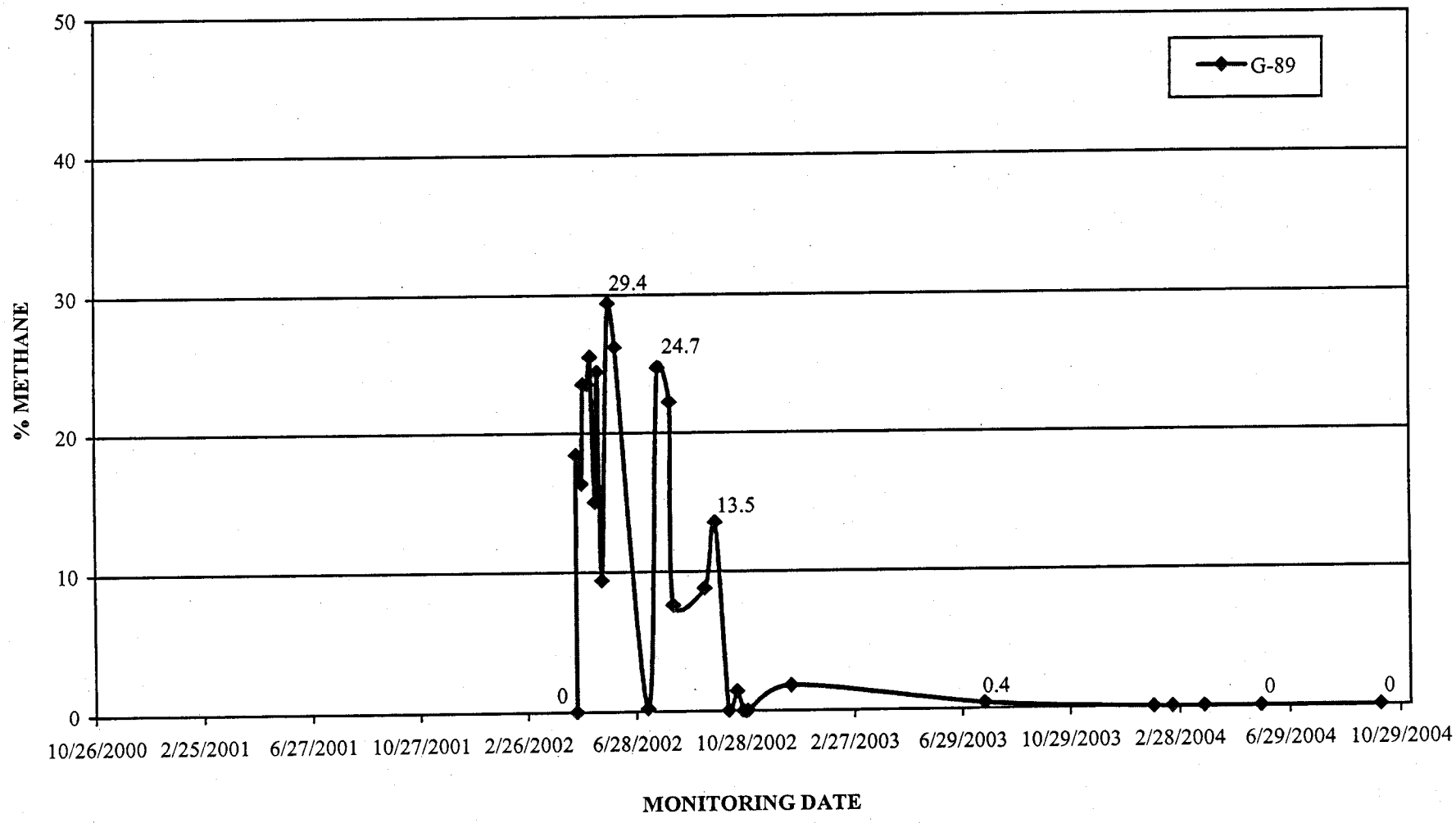

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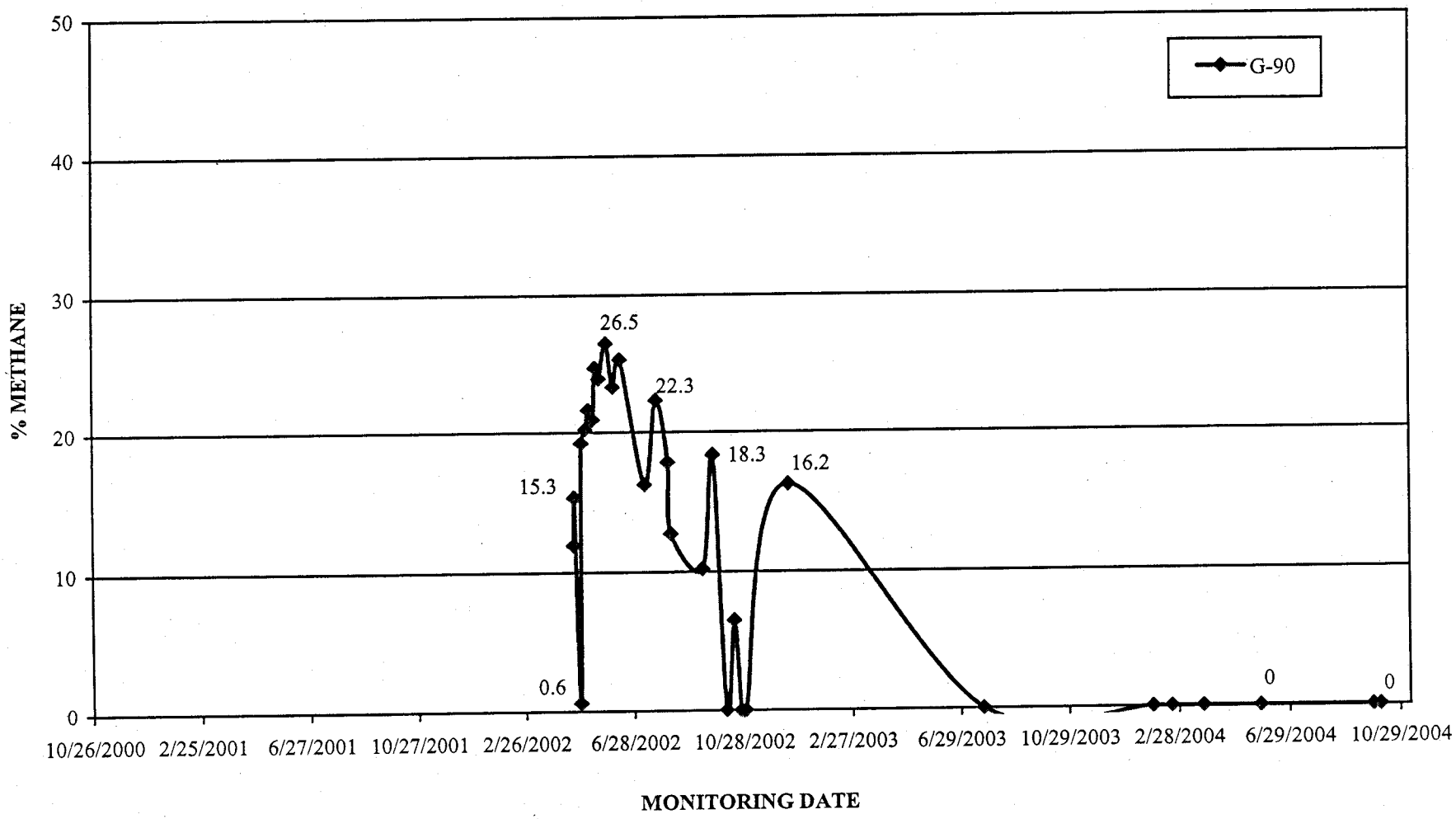

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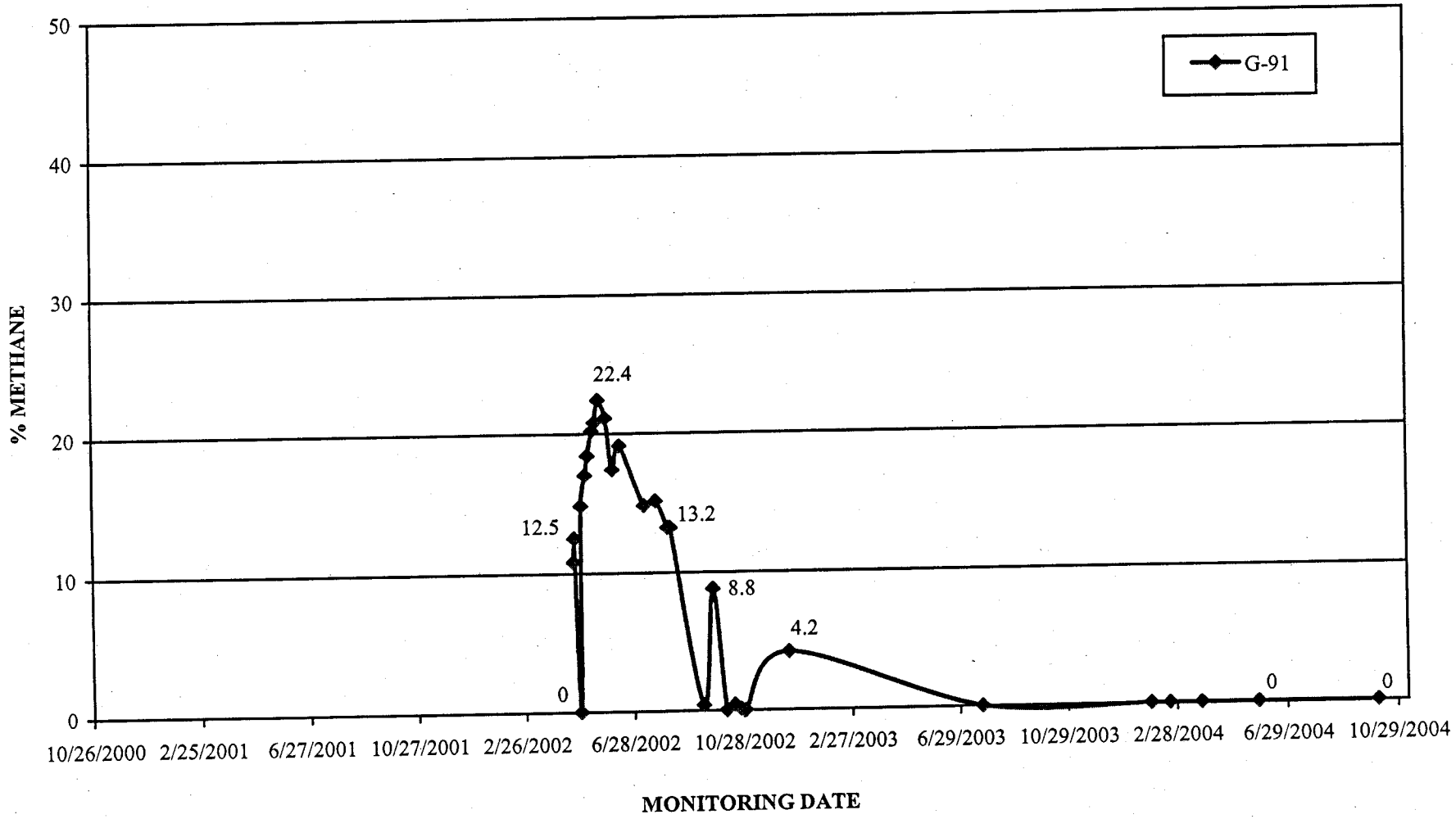

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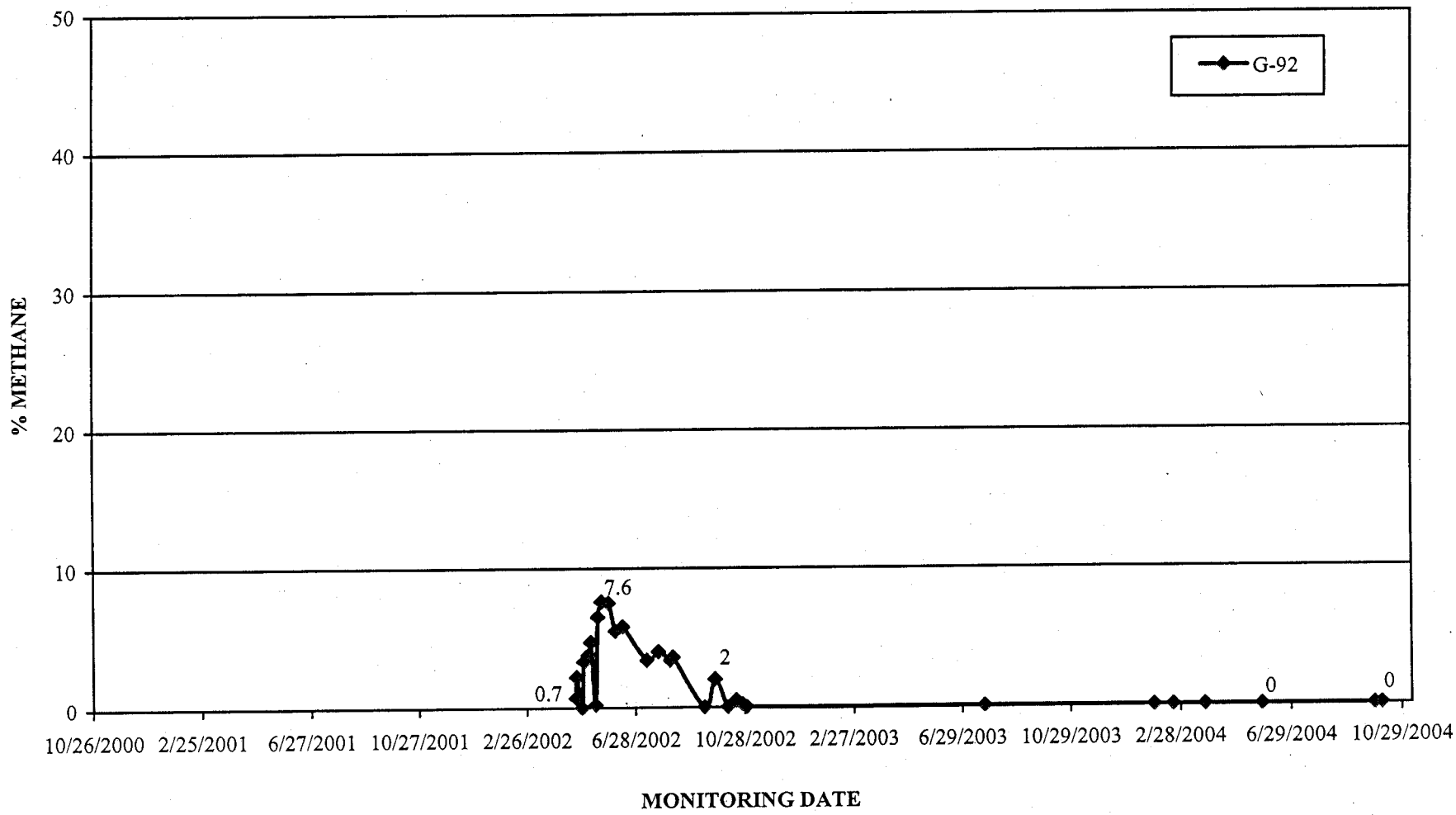
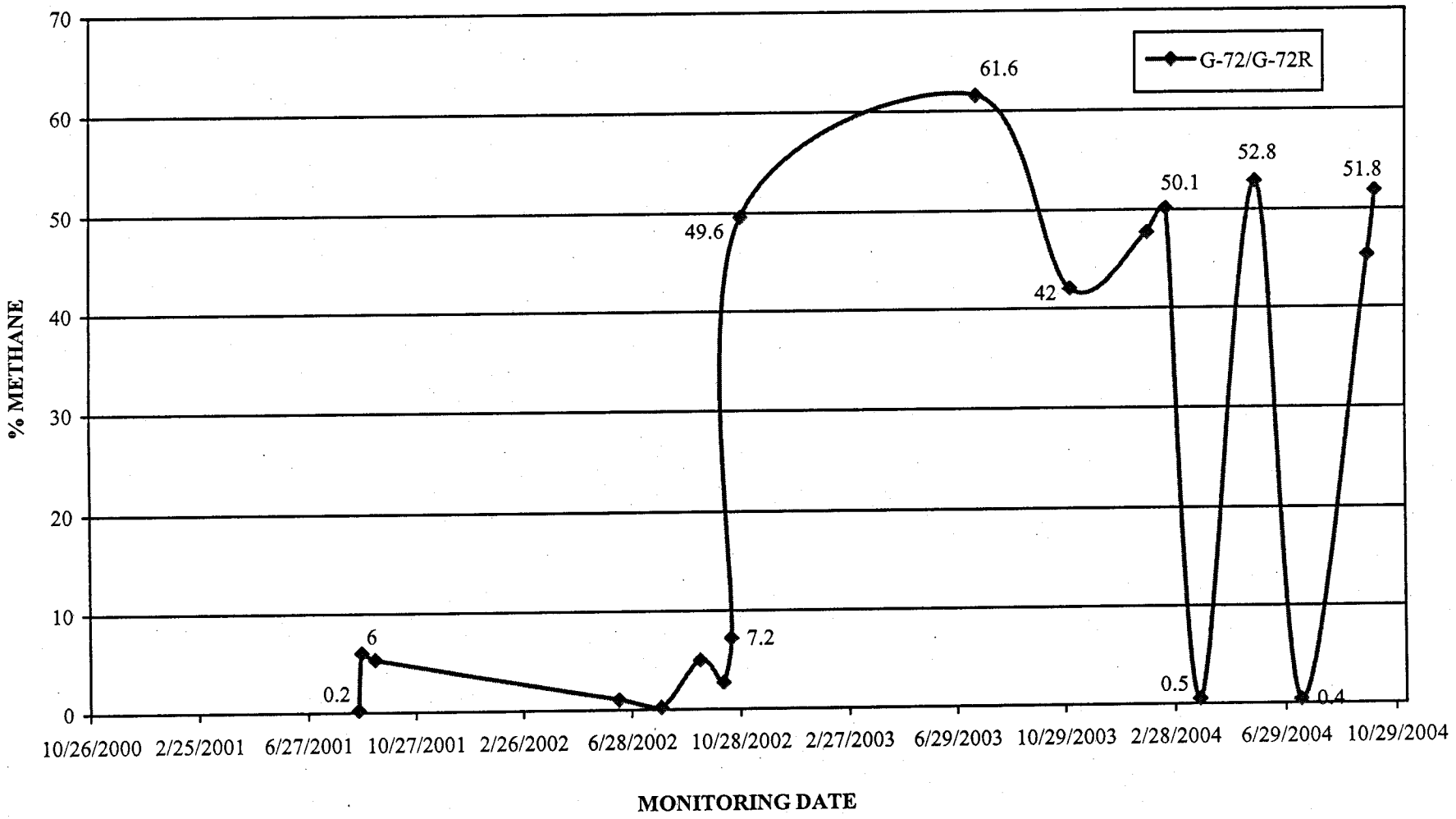


5/11/2005

APPENDIX D

MONITORING DATA FOR TEMPORARY LFG MONITORING PROBES NOT INDICATING DECREASING METHANE TREND

METHANE MIGRATION TRENDS IN TEMPORARY LFG MONITORING PROBES
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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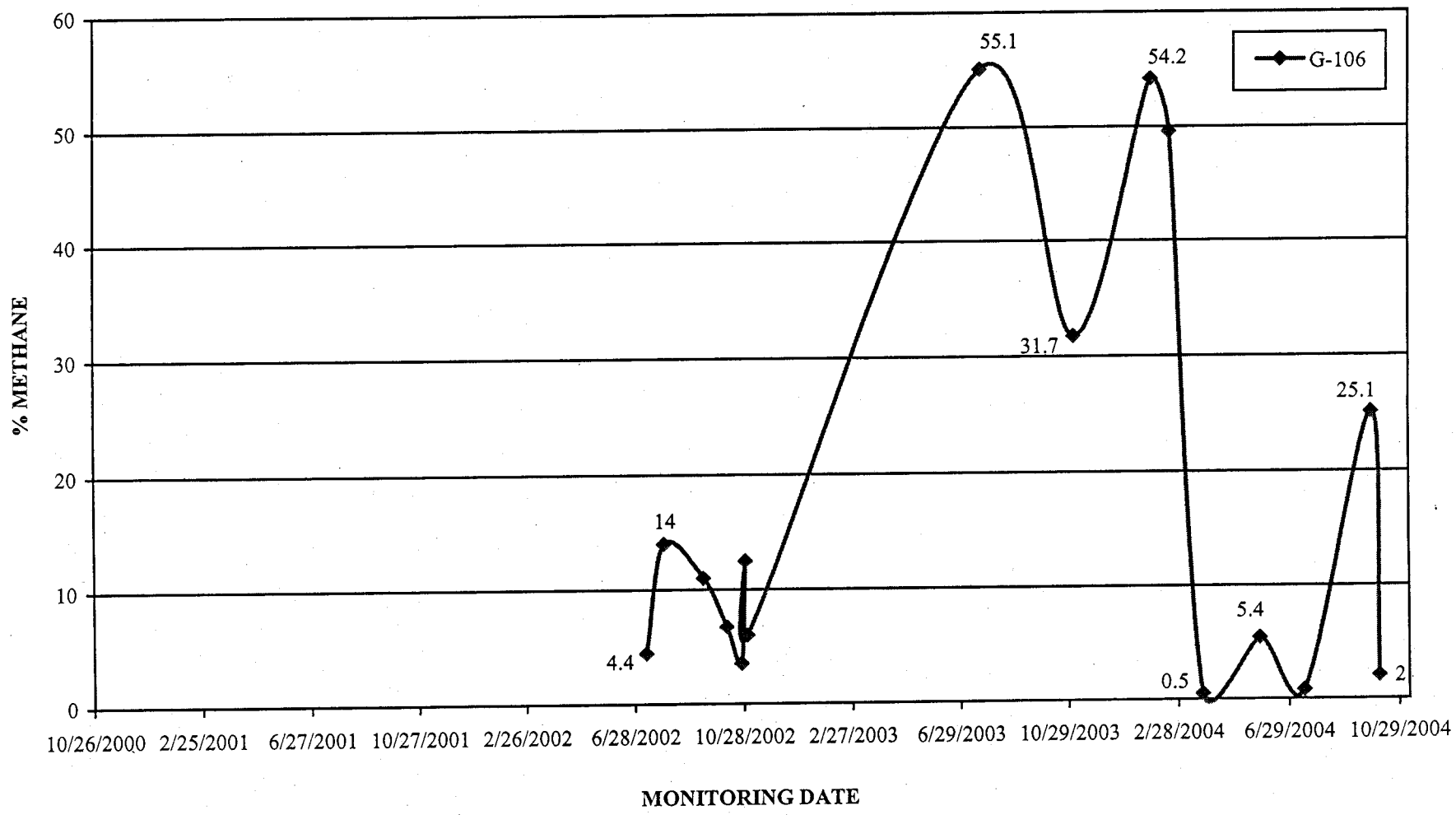

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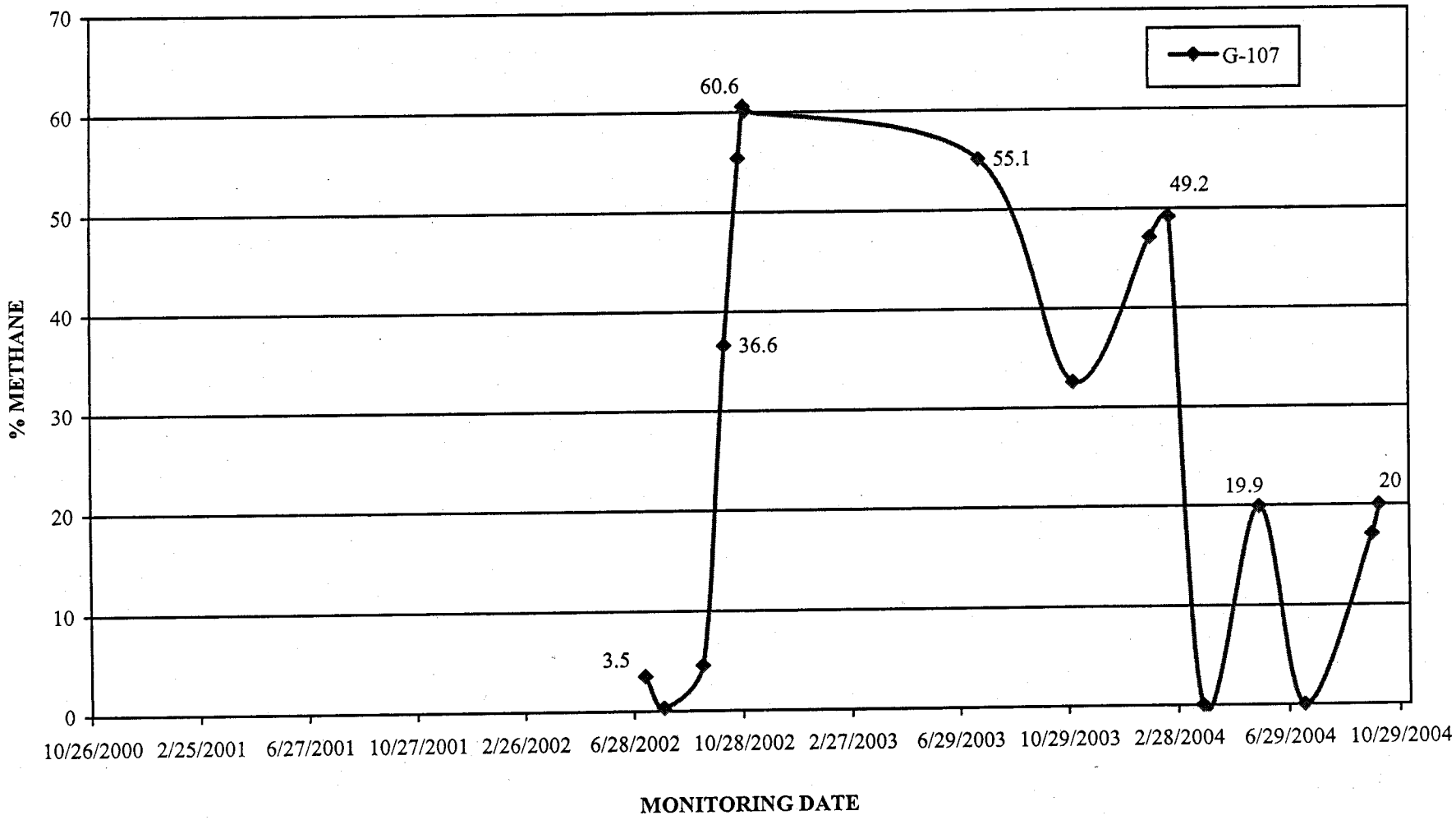

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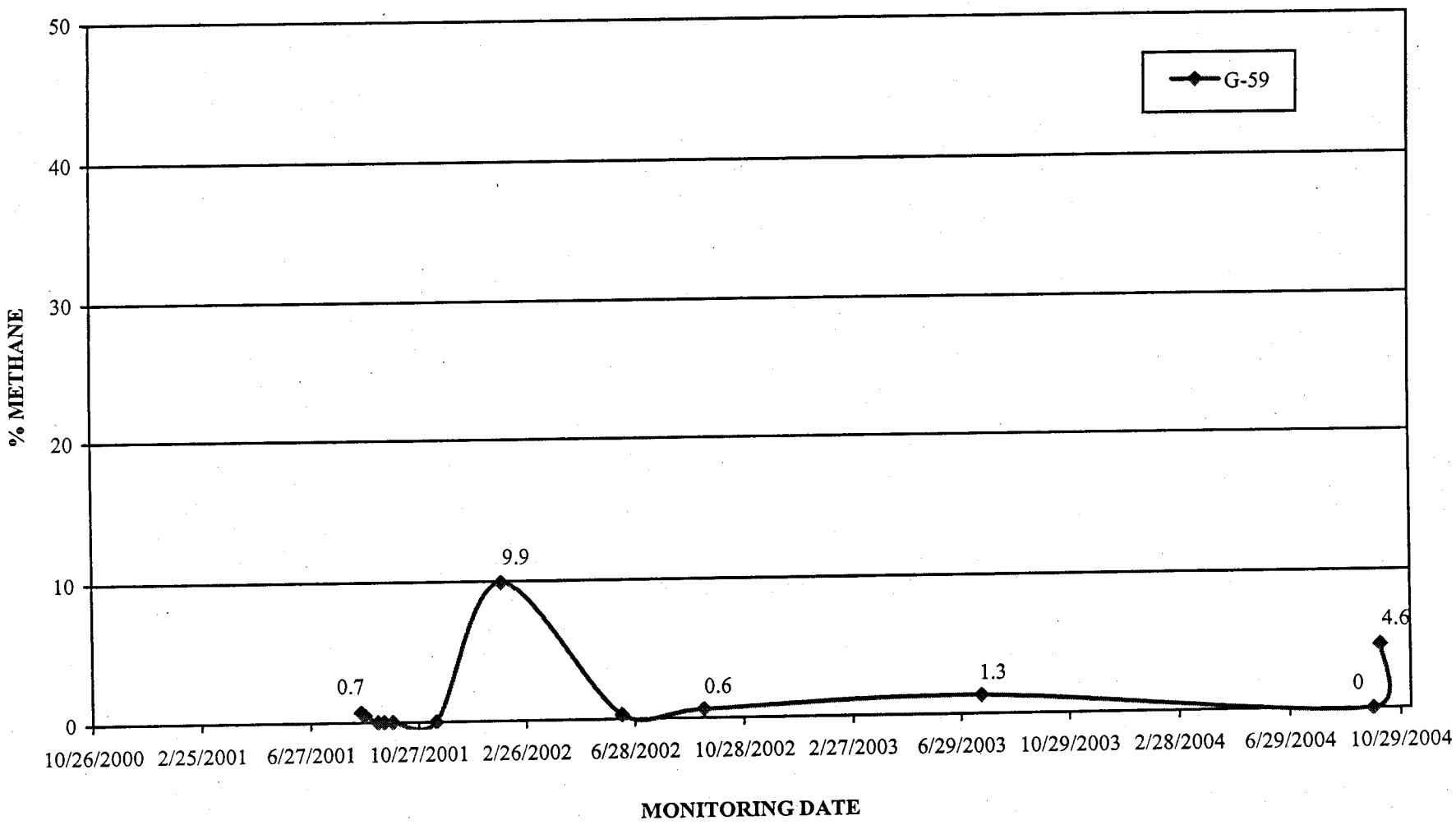

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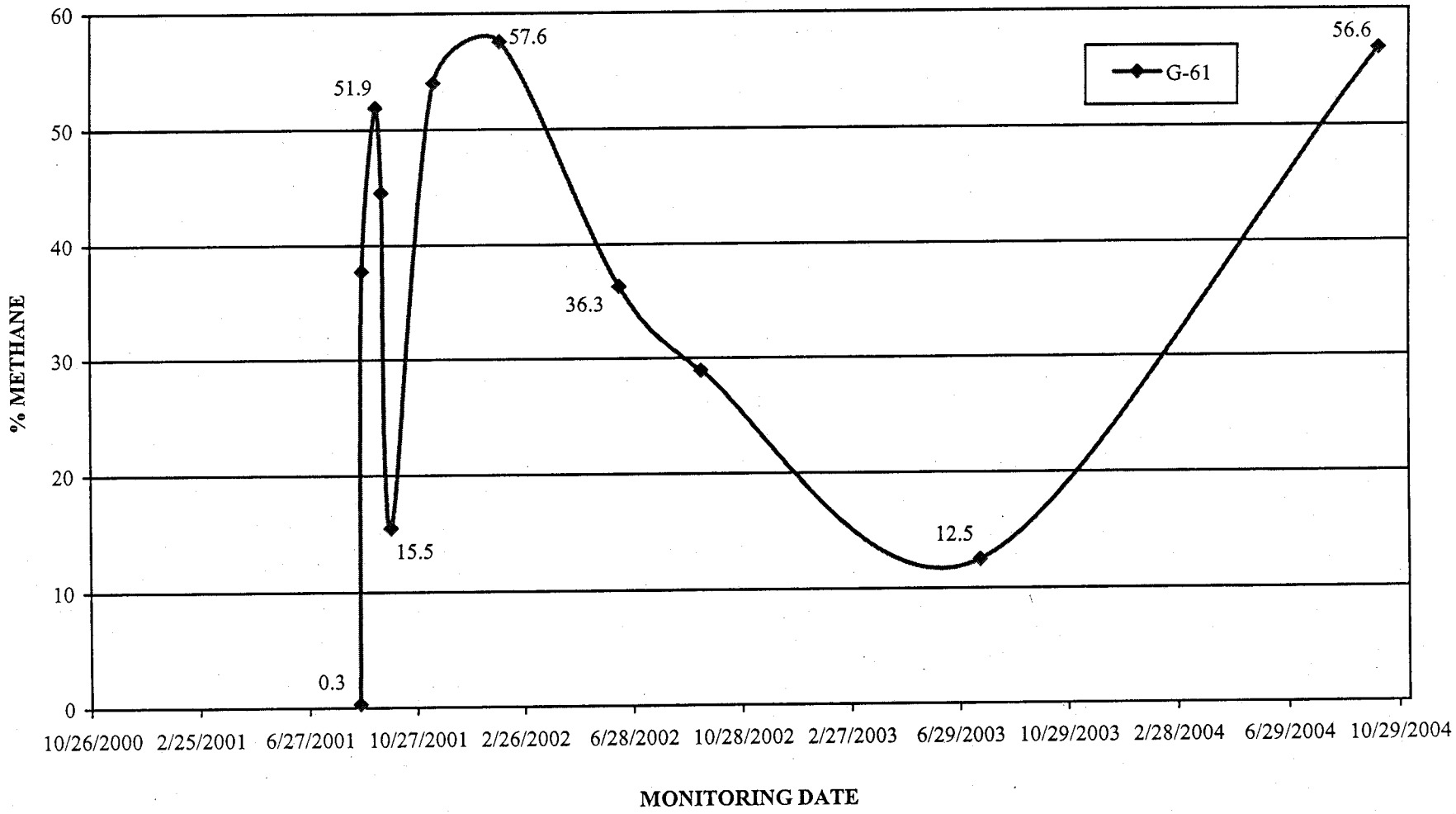

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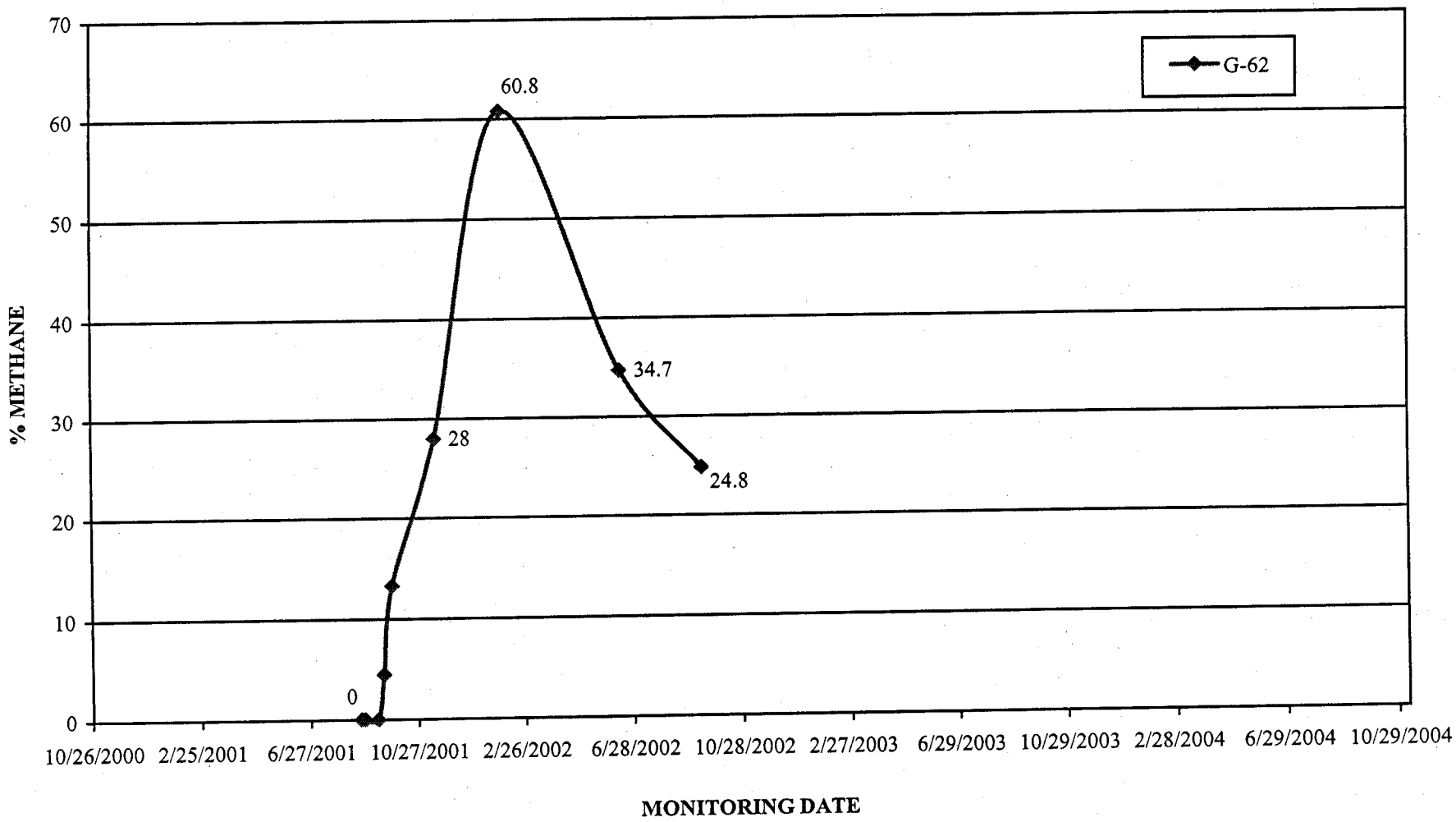

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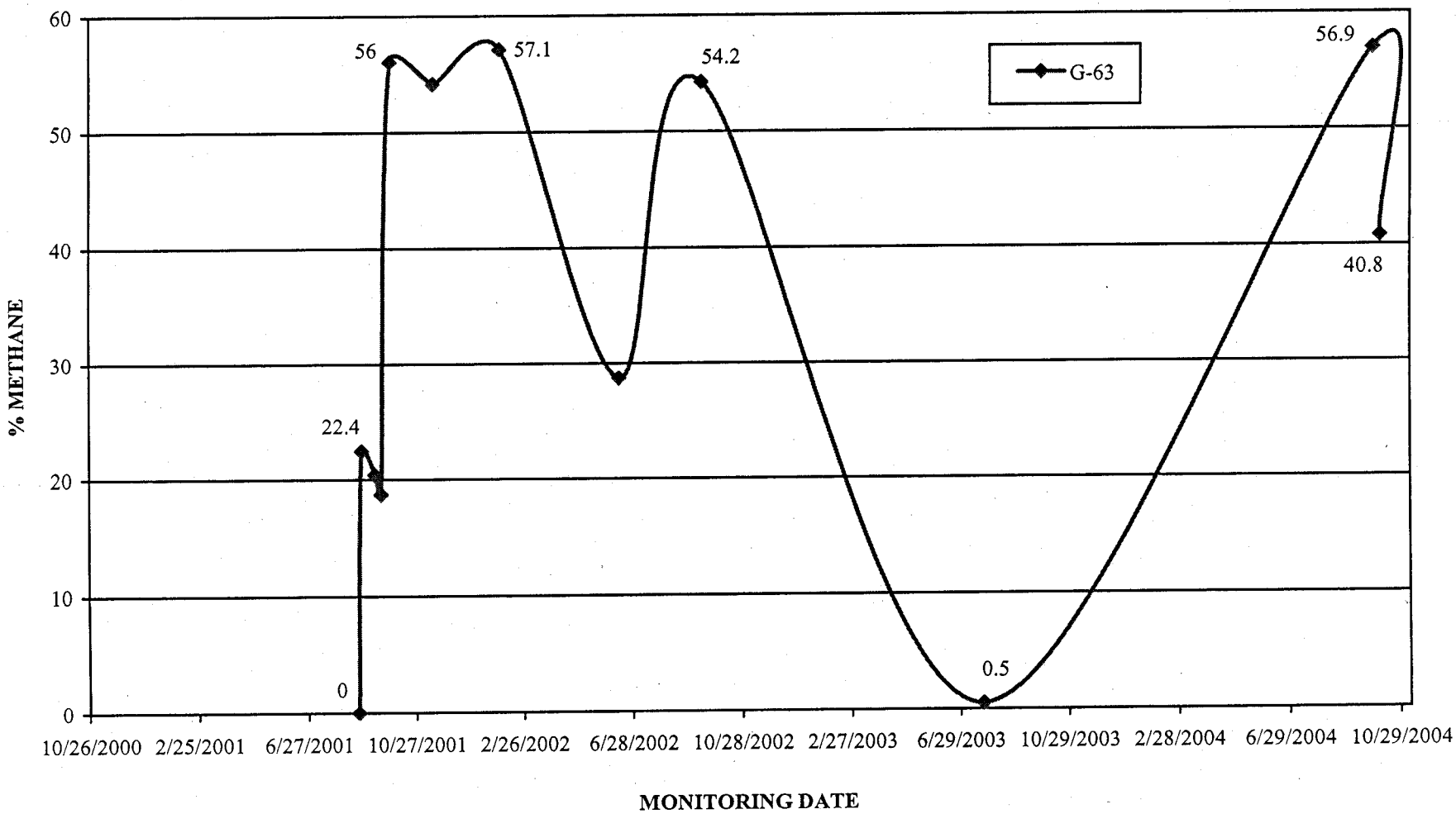

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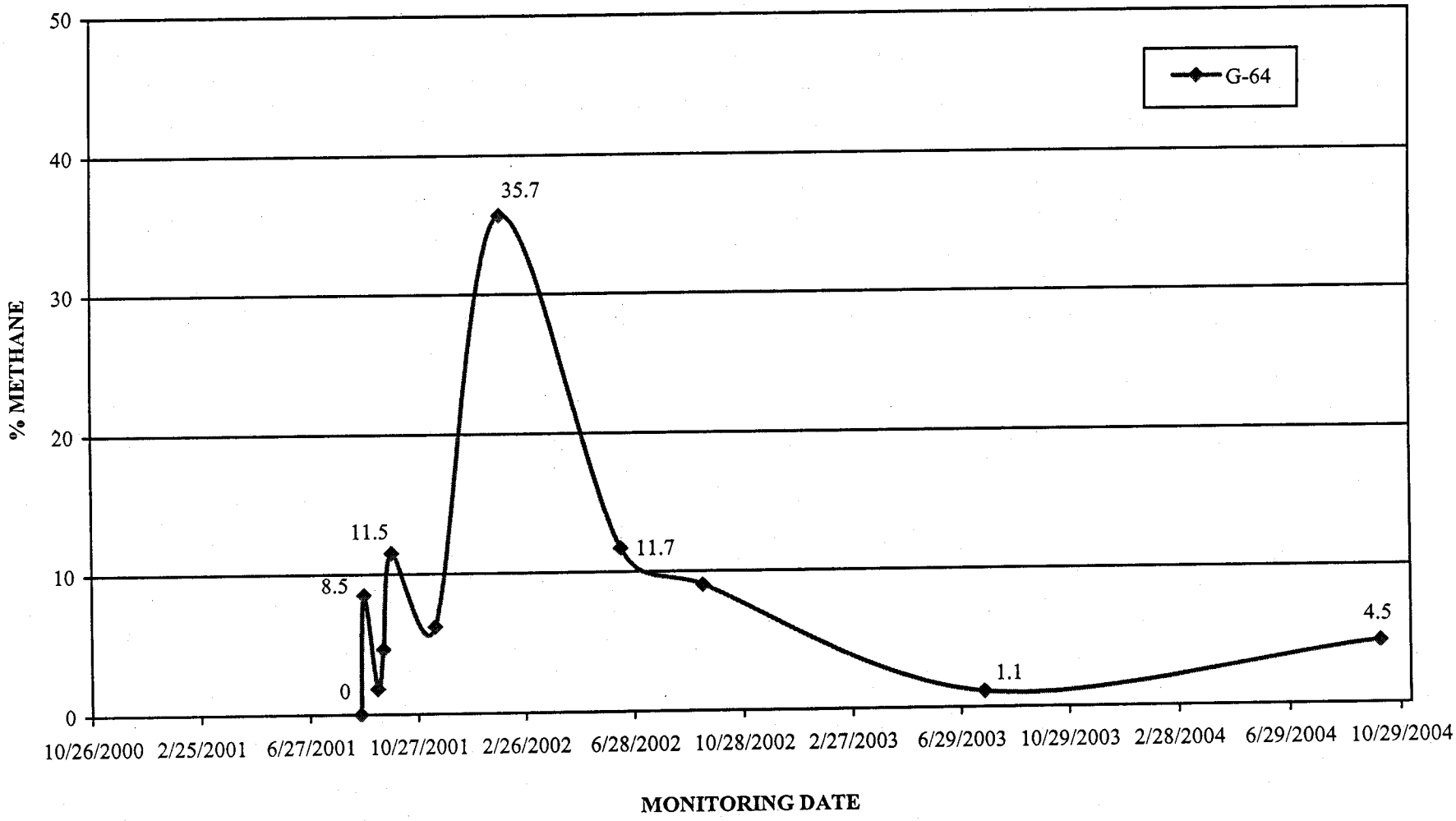

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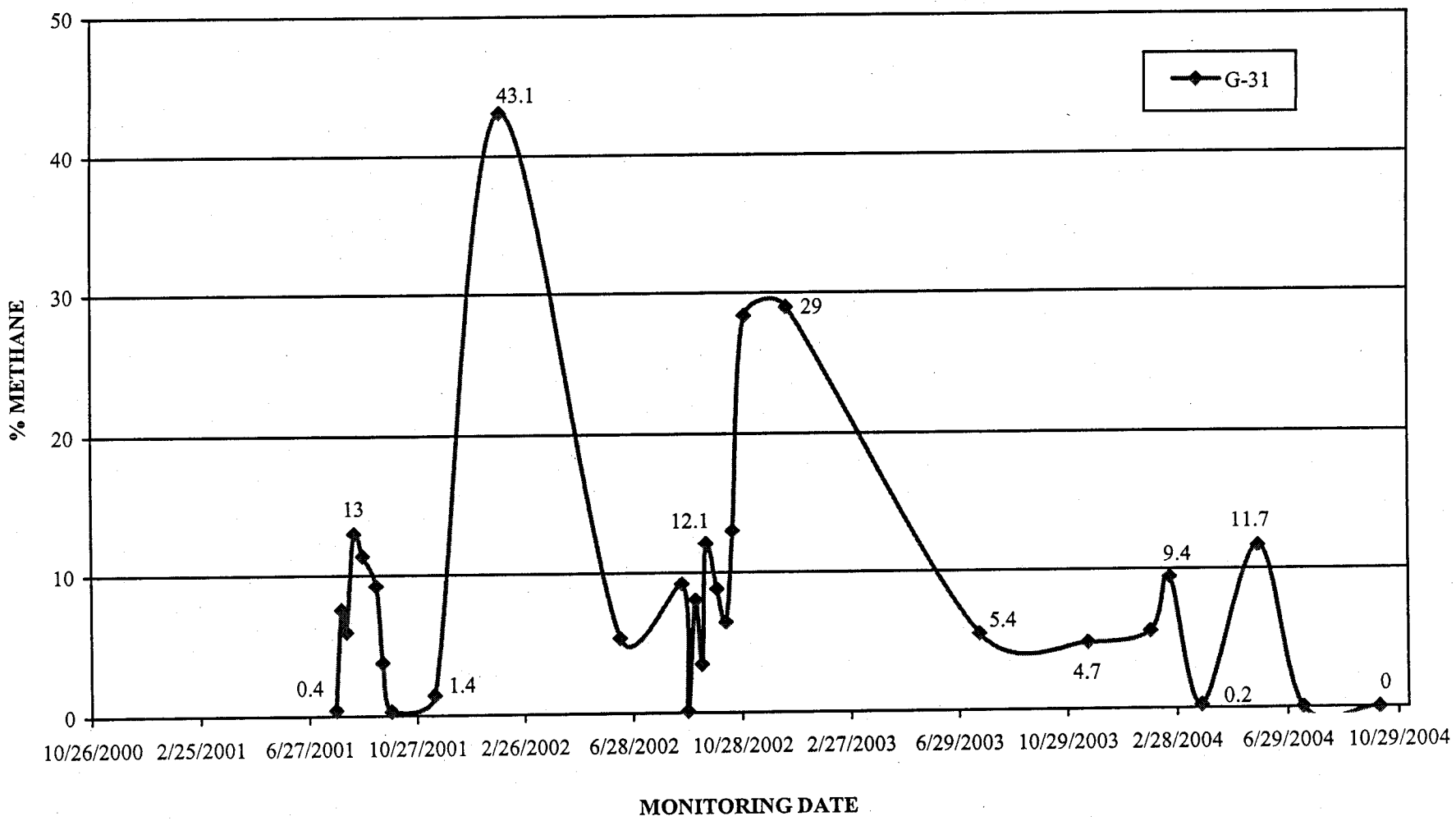

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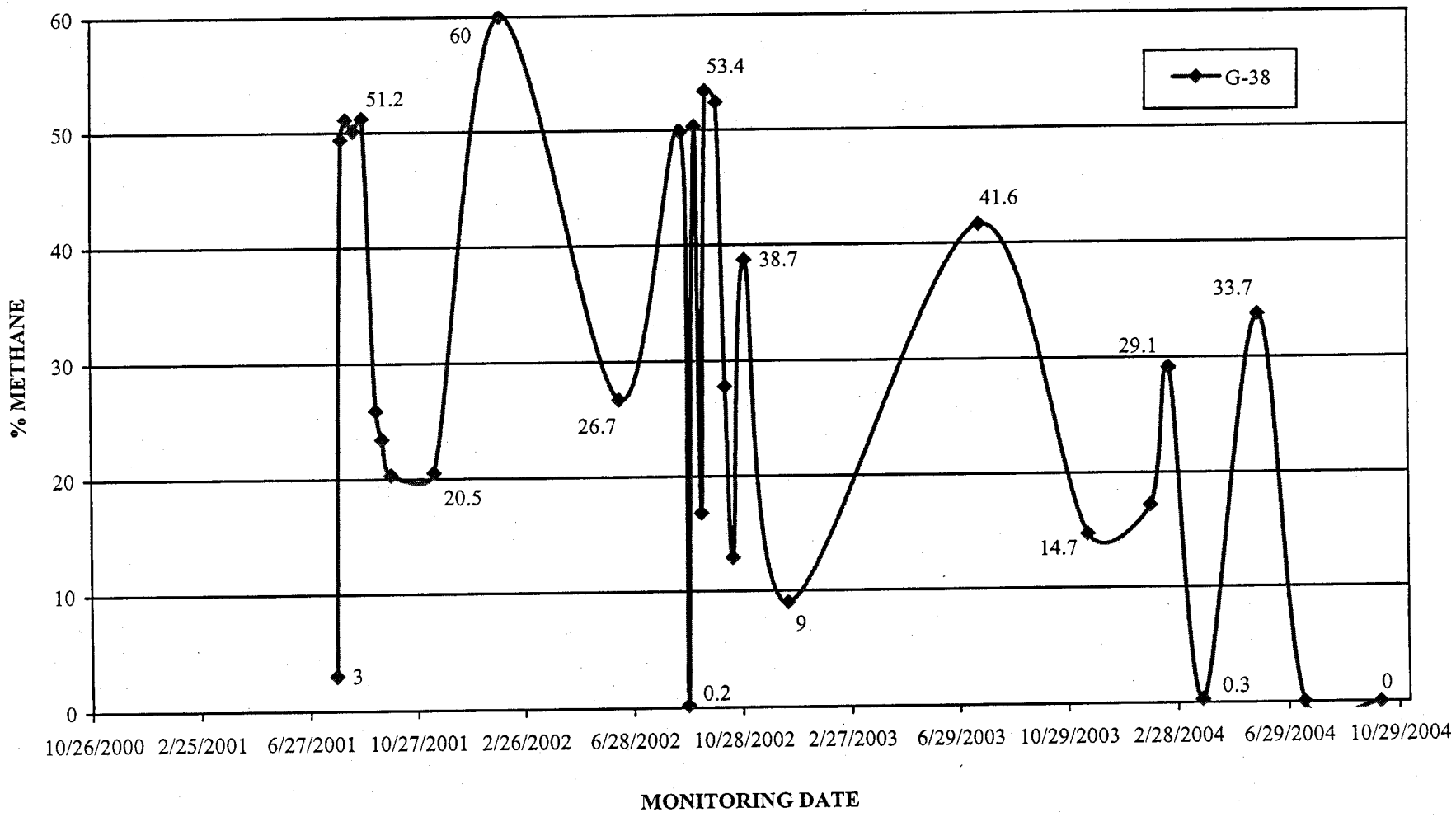

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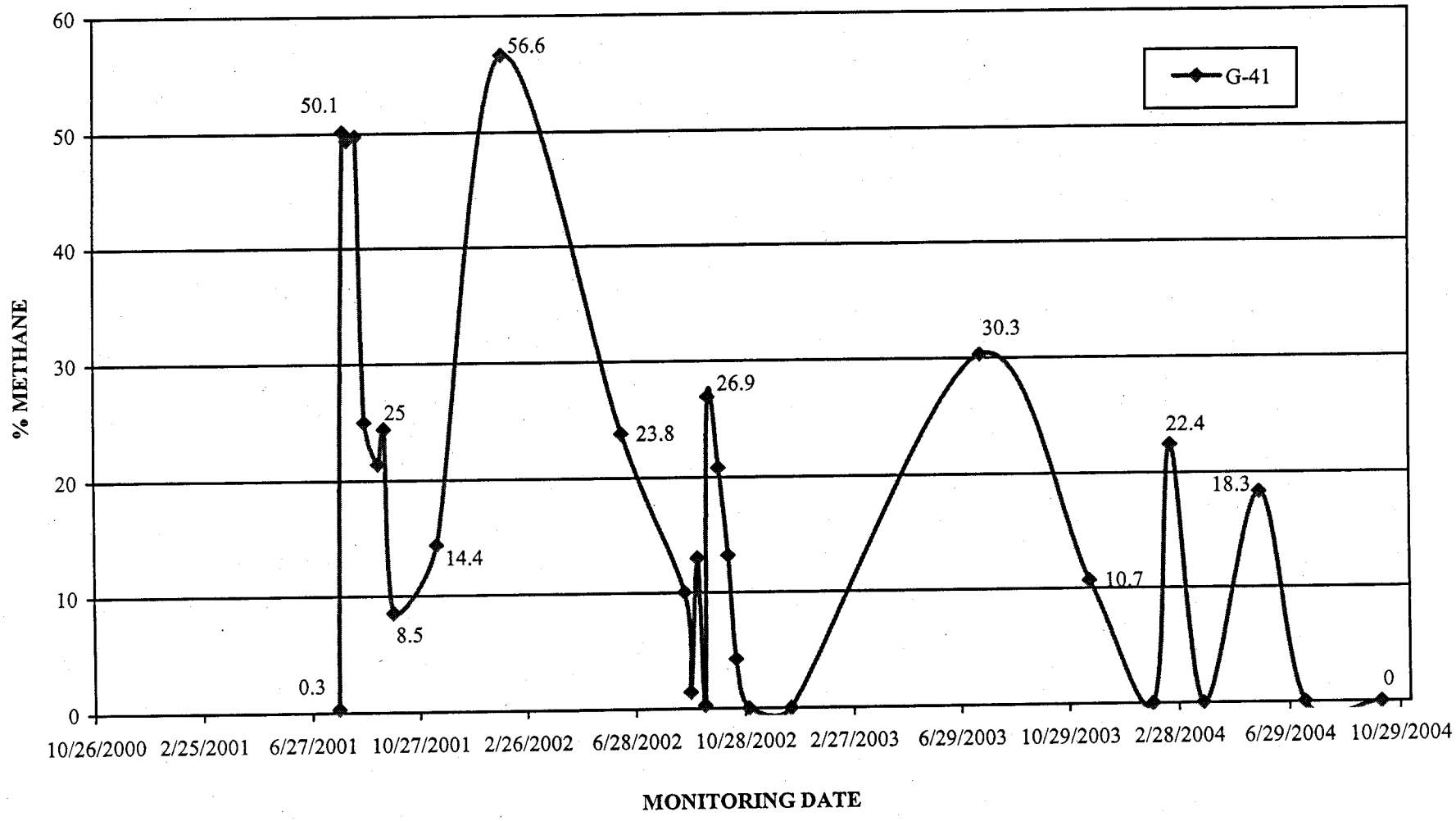
METHANE MIGRATION TRENDS IN TEMPORARY LFG MONITORING PROBES
NORTH WAKE COUNTY LANDFILL - UNLINED AREA



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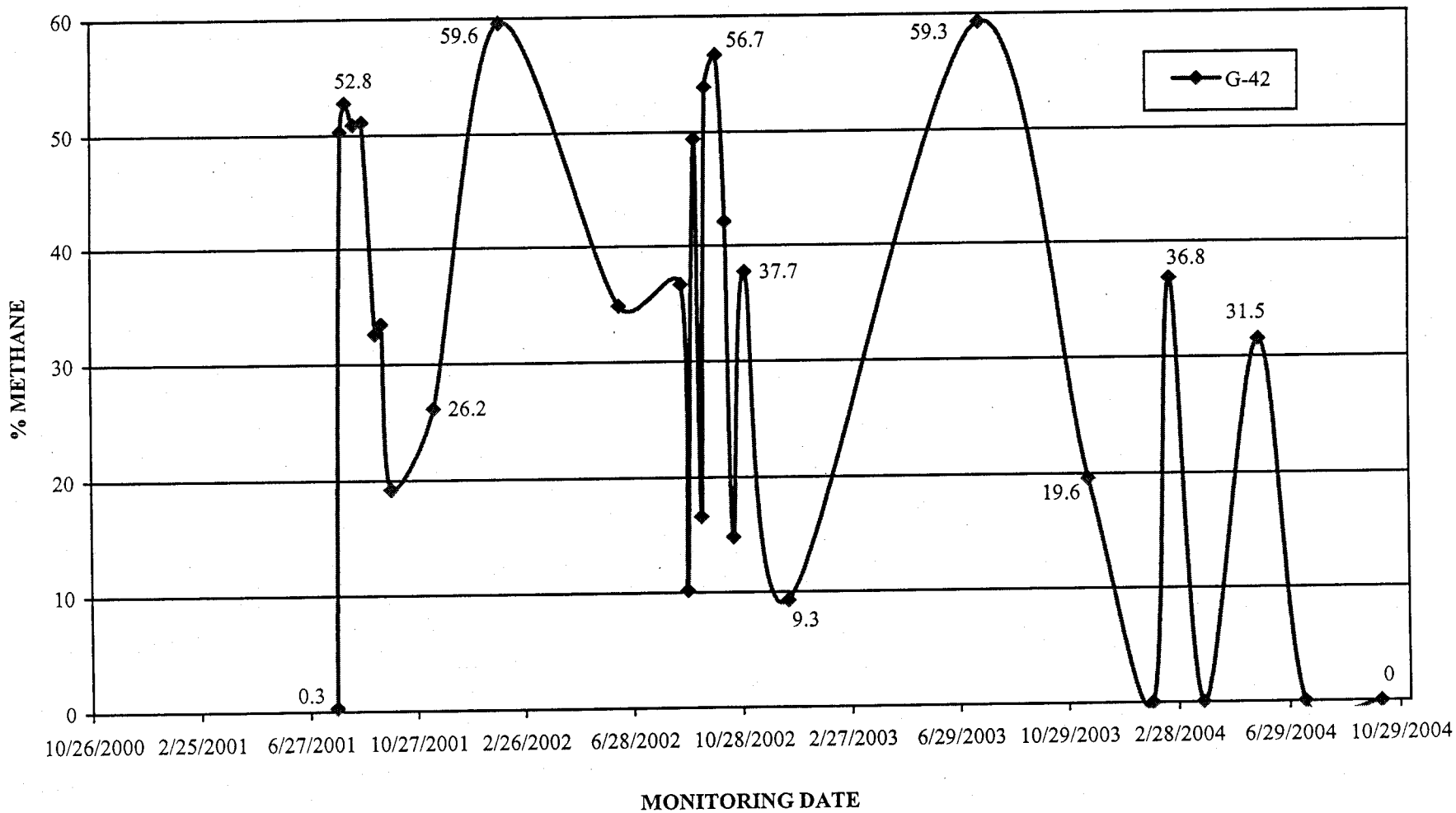

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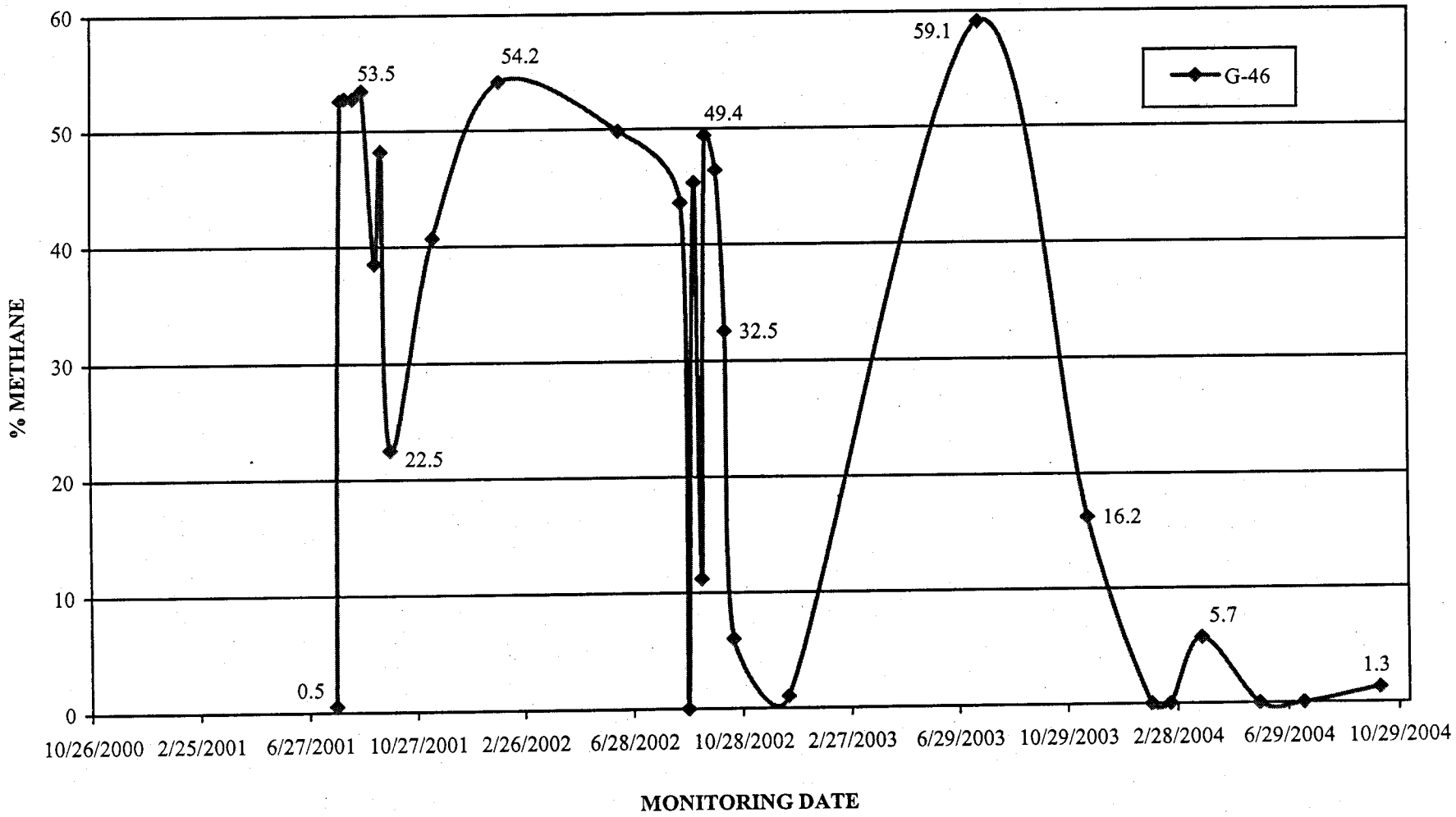

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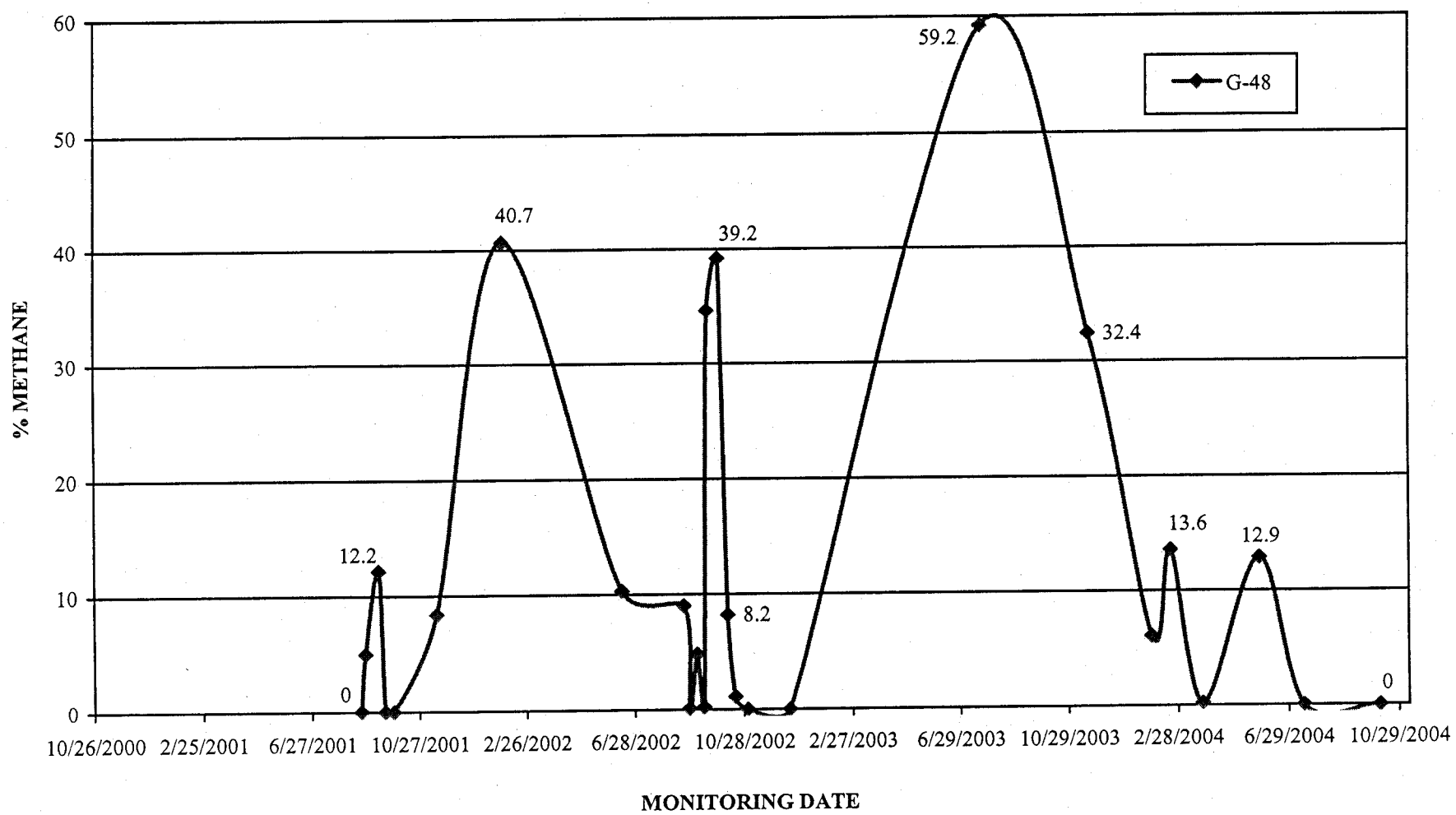

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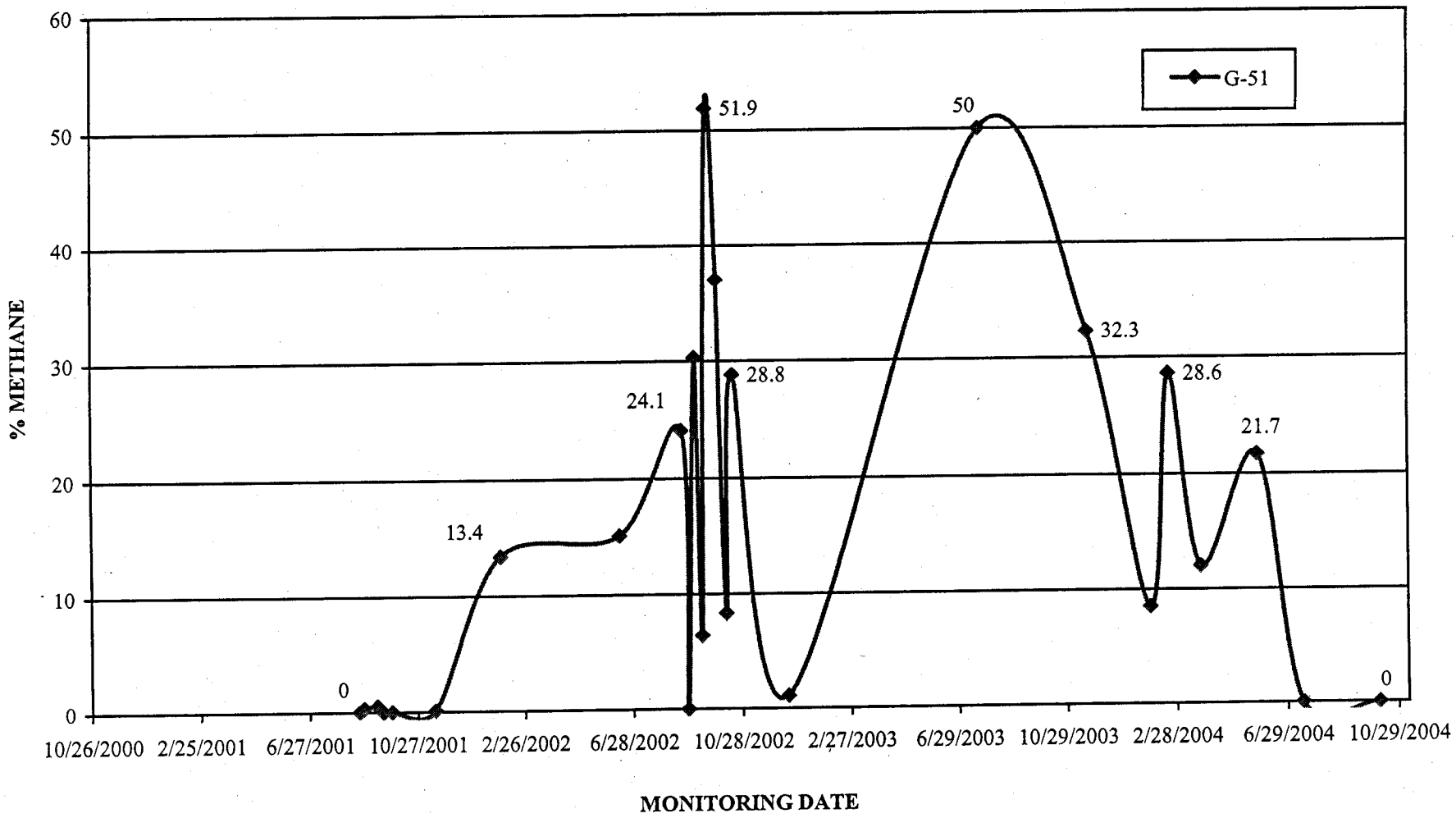

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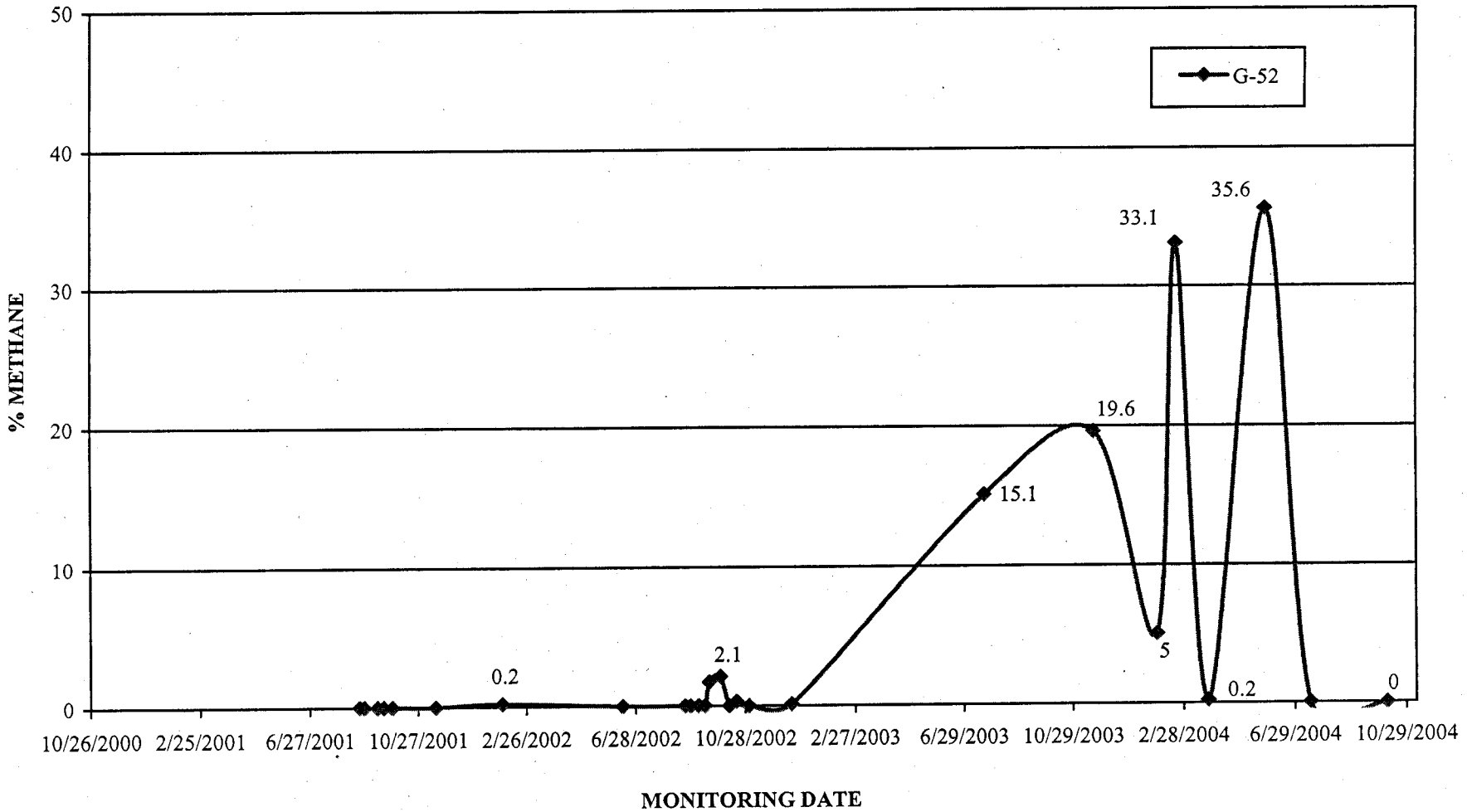

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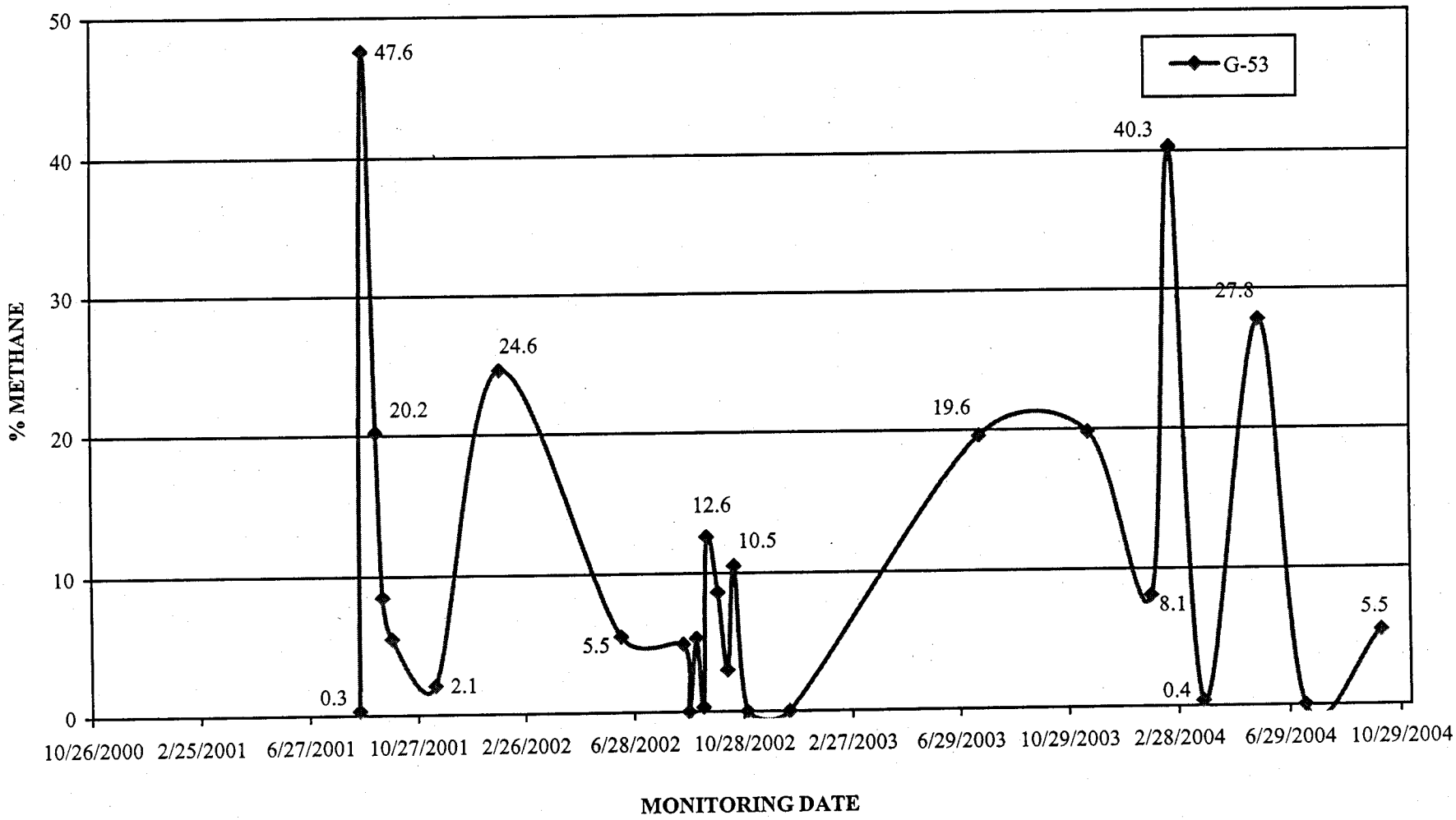

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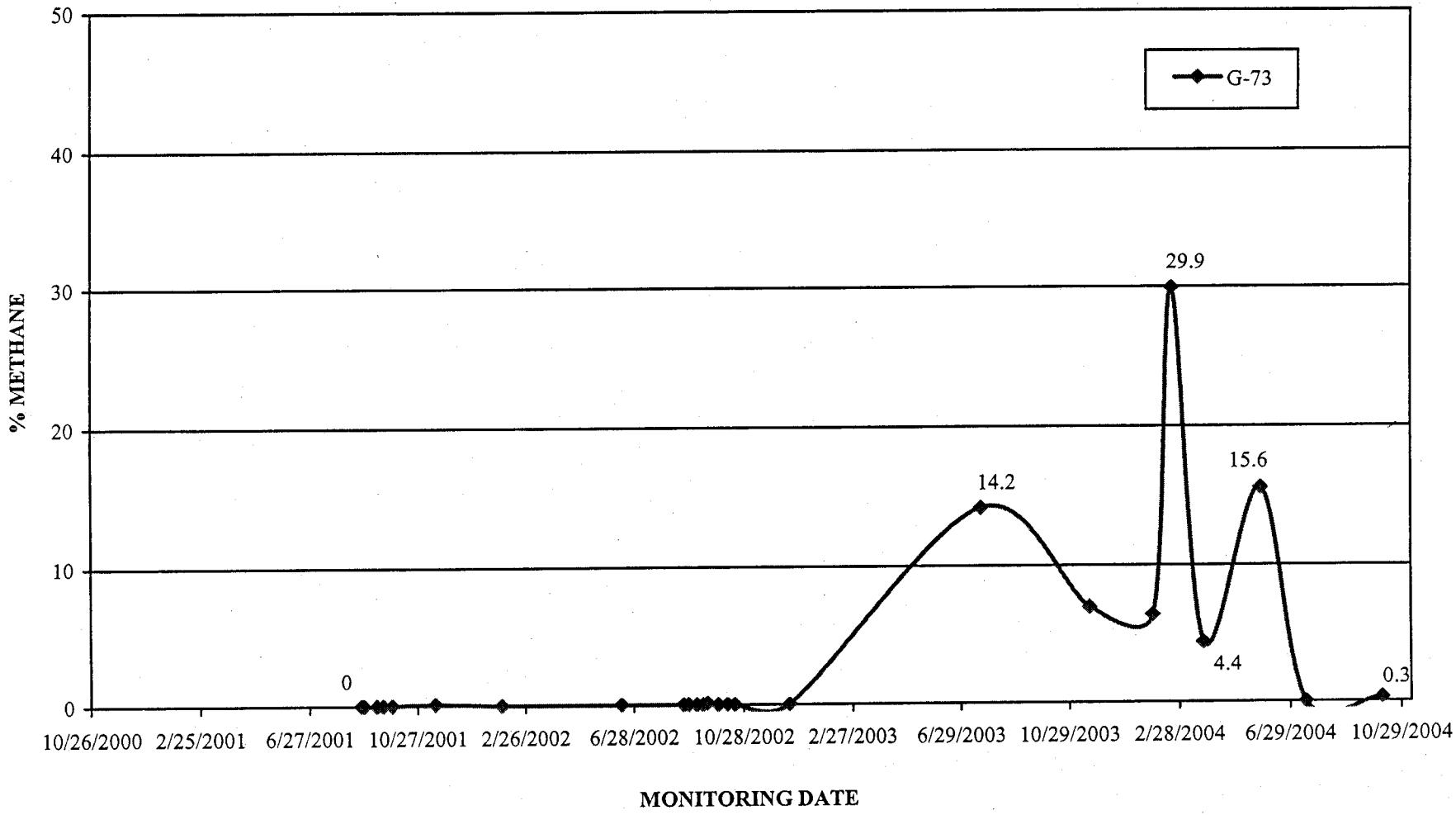

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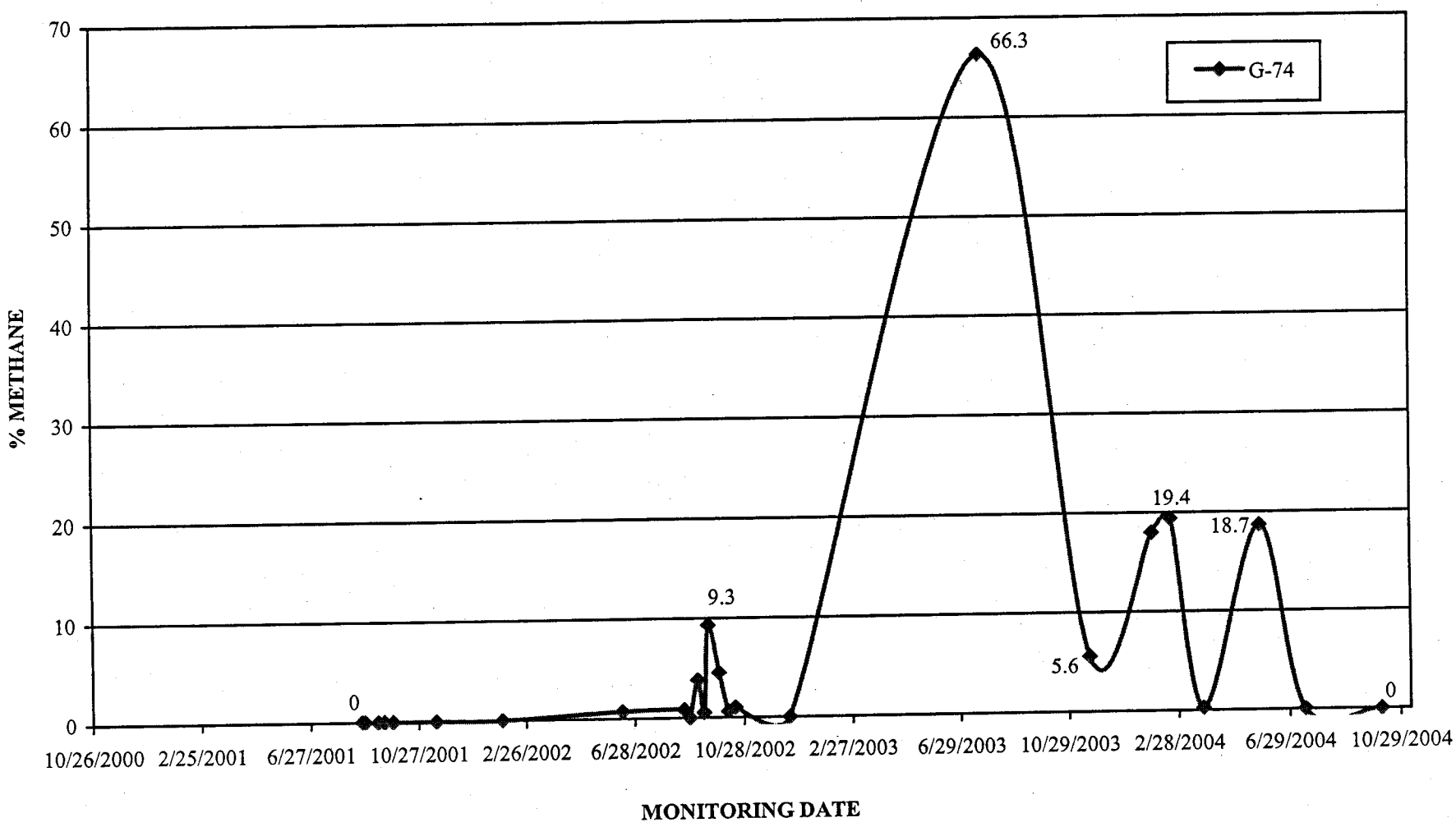

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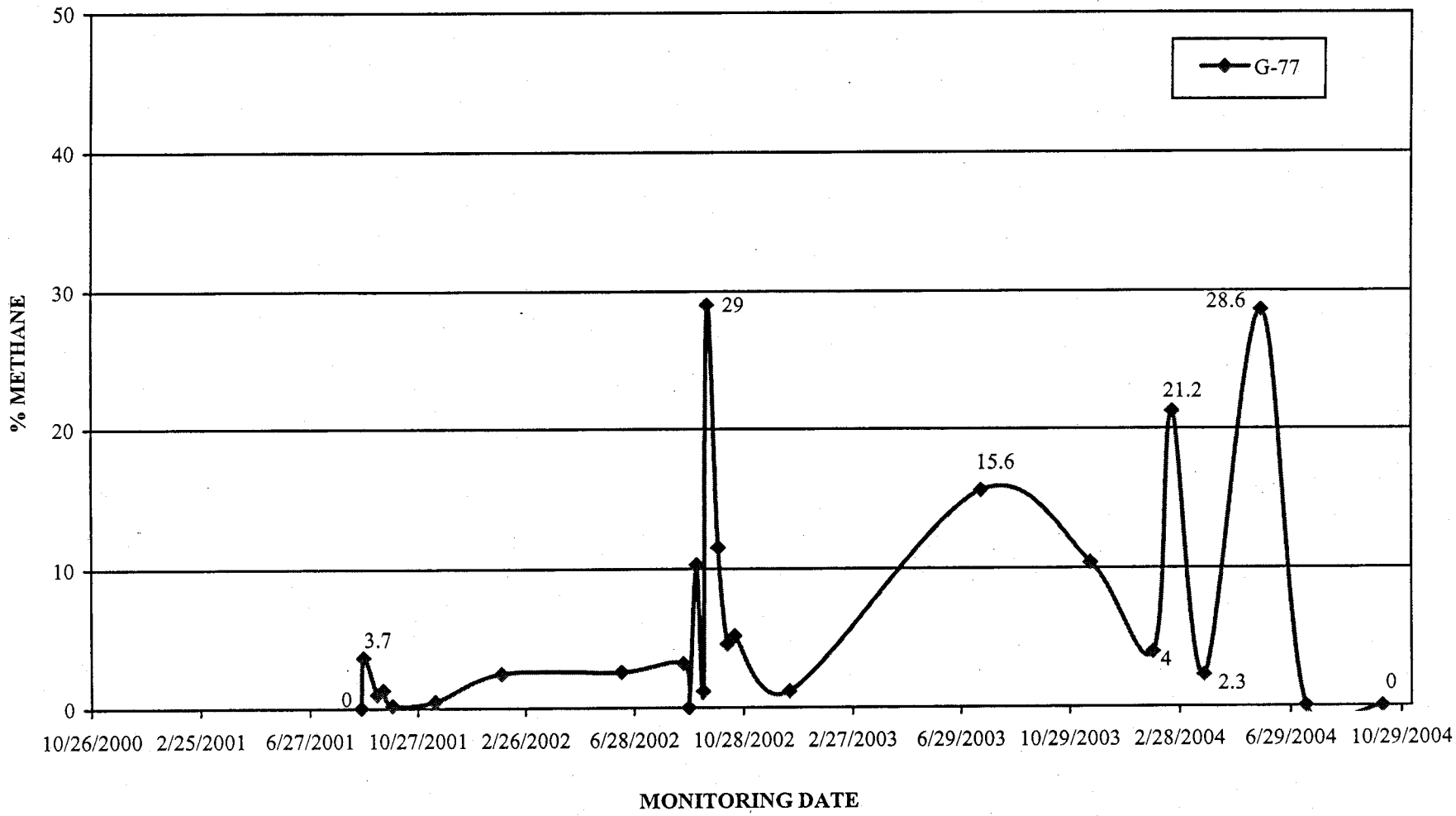

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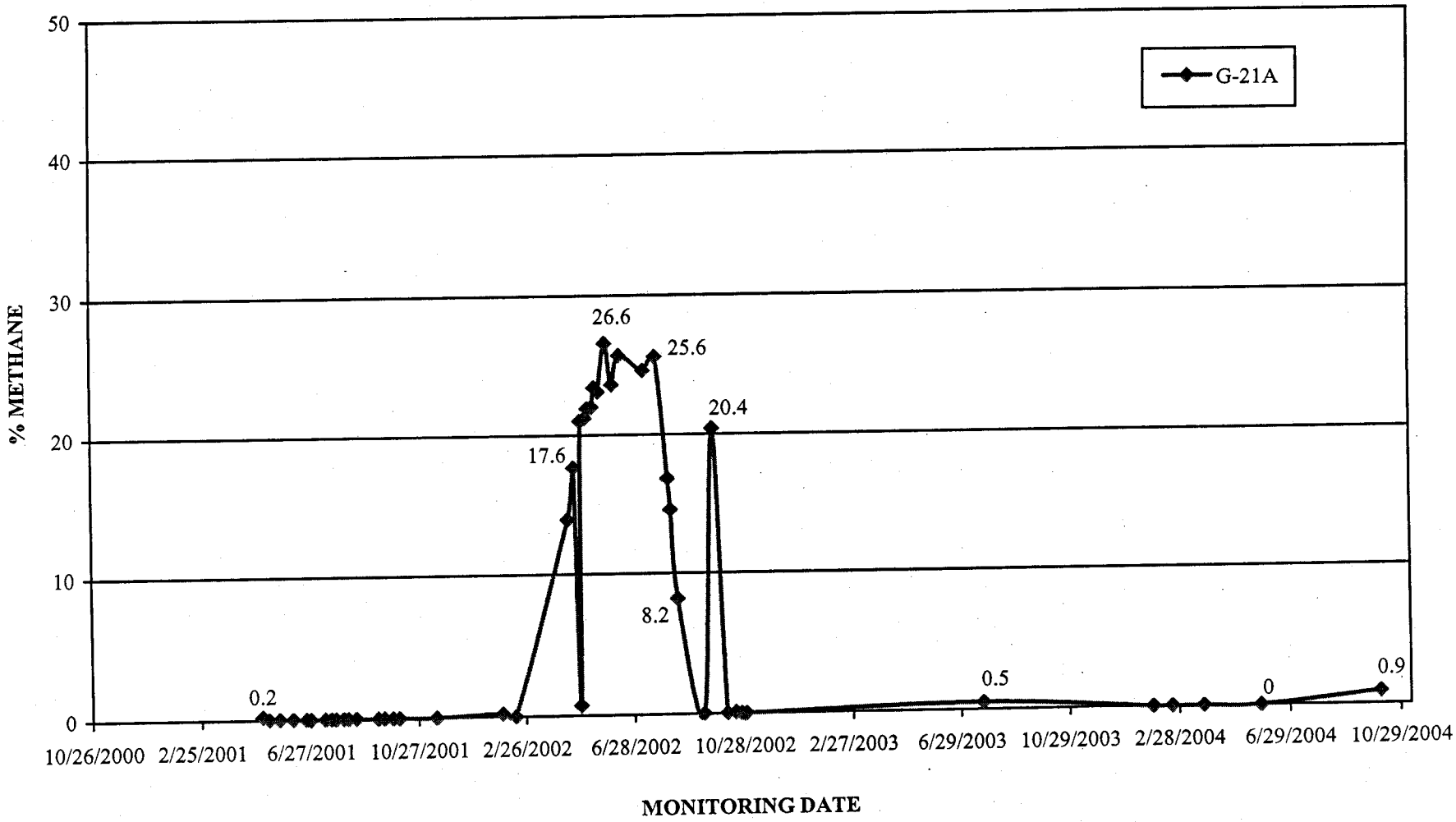

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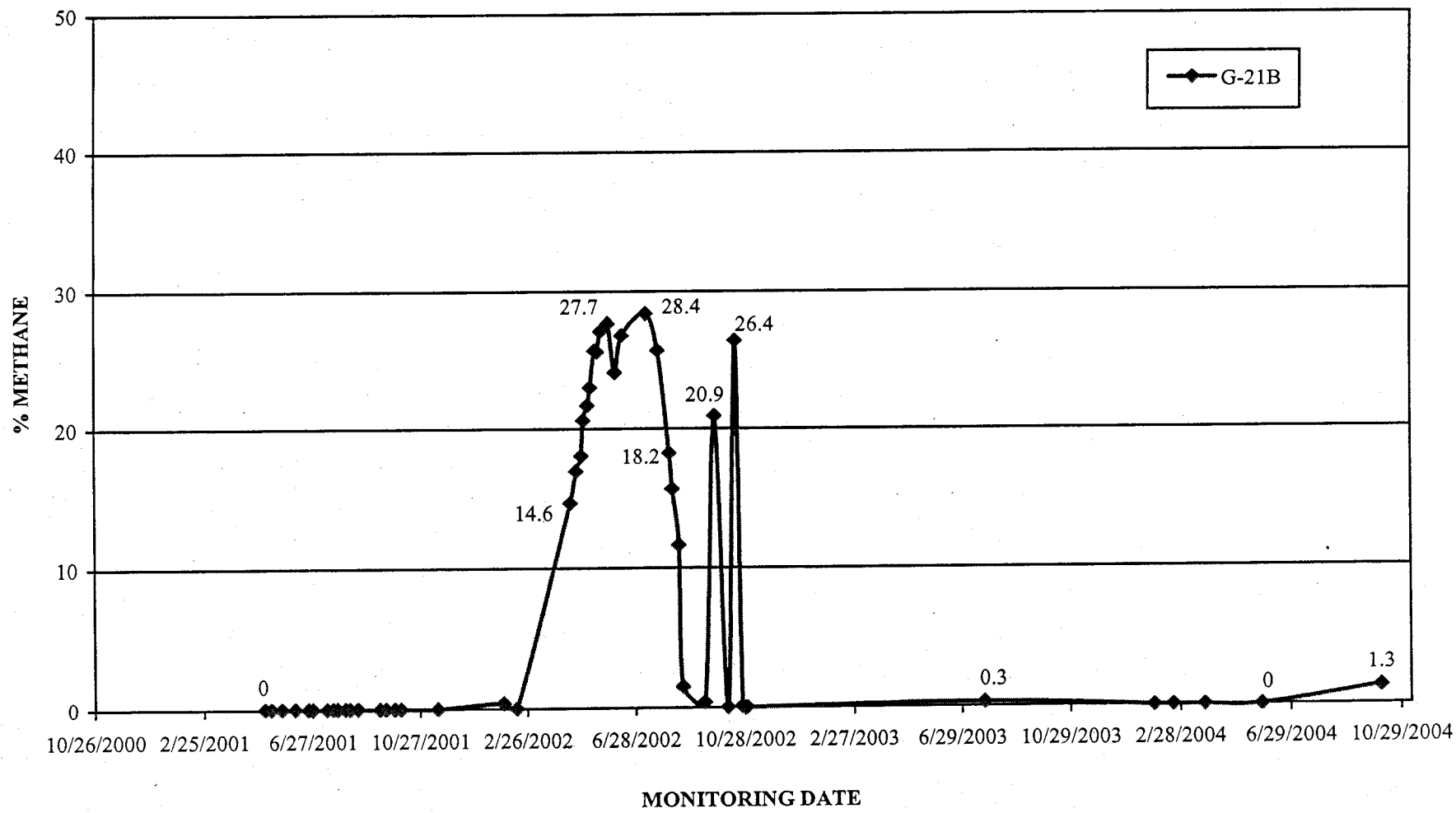

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